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About the organization

Founded in 1915, Building Officials and Code Administrators International, Inc., is a non-profit municipal service organization dedicated to professional code administration and enforcement, and to community development in general. The organization's goals encompass two main areas of service to the public and code administration profession, namely:

1. to serve the public by advocating the use of safe, suitable and modern construction techniques and materials through the BOCA model codes program; and
2. to serve governmental jurisdictions and their code administration personnel by providing technical information and services related to all specialty areas of code administration and enforcement, as well as through BOCA's complete model codes maintenance program.

Because of the international nature of the BOCA membership, and the wide variety of building and construction personnel the membership comprises, the BOCA organization promotes the exchange of ideas and experiences of code administrators from the United States and many other countries.

In addition to the *BOCA Basic Code* series described as follows, BOCA also participates in the publication of the *One and Two Family Dwelling Code*, a document jointly published by BOCA and other model code groups. The BOCA organization, the nation's oldest professional association of practicing building officials, also participates actively in the Council of American Building Officials, and is an active supporter of the National Academy of Code Administration. BOCA's executive offices are located in the Center for Public Administration on the campus of the University of Chicago.

As a non-profit professional association, BOCA International is supported exclusively through membership dues, fees received for technical services and income received from the sale of *BOCA Basic Codes* and other publications. Because of this, outside printings of the *BOCA Basic Codes*, or portions thereof, are expressly prohibited.

A detailed account of the *BOCA Basic Code* series, BOCA's democratic code revision process, other BOCA Publications, and the complete package of BOCA's professional building department services appears as follows.

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The complete model code services program of Building Officials and Code Administrators (BOCA) International is dedicated to the improvement of building regulations, and the effective administration, organization, and methods of enforcement of these regulations by professionally-staffed local governmental units.

To accomplish this, BOCA provides a complete model code services package, the "backbone" of which is the *BOCA Basic Code* series. *Basic Codes* available in completely revised and updated 1975 editions include the *Basic Building Code, Basic Mechanical Code, Basic Plumbing Code, Basic Fire Prevention Code, Basic Housing–Property Maintenance Code* and *Basic Industrialized Dwelling Code.*

(Continued on inside back cover)

The BOCA *Basic Mechanical Code* / 1975

SECOND EDITION

As recommended and maintained
by the active membership of

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC.
1313 East 60th St. • Chicago, Illinois 60637
Founded in 1915 312/947-2580

NOTE: The BOCA Basic Codes are designed for adoption by state or local governments by reference only. Jurisdictions adopting them may make necessary additions, deletions and amendments in their adopting document. Incorporation of any part of the BOCA Basic Codes in codes published by states, local governments, regulatory agencies, individuals or organizations is expressly prohibited. When your jurisdiction has adopted one or more of the BOCA Basic Codes, please send a copy of the adopting document to: Executive Director, BOCA International, 1313 East 60th Street, Chicago, Illinois 60637.

Jurisdictions wishing to adopt the BOCA *Basic Mechanical Code, 1975*, as an enforceable regulation governing mechanical equipment and use, should make sure certain factual information is included in the code text and adopting ordinance at the time adoption is being considered by the appropriate governmental body. The required information, which indicates applicability of the code to a particular jurisdiction, can be itemized as follows:

1. The *name of the jurisdiction* should be inserted in the second line of *Section M-100.3* on Page 1 of the code.
2. The *date of adoption* of the code should be inserted in the first line of *Section M-102.1* on Page 1 of the code.
3. The *name of the jurisdiction* should be inserted in the second line of "Air for combustion" in *Section M-201.0* on Page 10 of the code.
4. The *name of the jurisdiction* should be inserted in the first line of "Department" in *Section M-201.0* on Page 16 of the code.
5. The *name of the jurisdiction* should be inserted in the first line of "Fire department" in *Section M-201.0* on Page 18 of the code.
6. The *name of the jurisdiction* should be inserted in the seventh line of "Gas" in *Section M-201.0* on Page 20 of the code.
7. The *name of the jurisdiction* should be inserted in the second line of "Rating input" in *Section M-201.0* on Page 25 of the code.
8. The *dollar amount* should be inserted in the appropriate places in *Table M-502* on Page 109 of the code.
9. The *dollar amount* should be inserted in the third line of *Section M-900.3* on Page 199 of the code.
10. The *name of the state* should be inserted in the fifth line of *Section M-904.1* on Page 217 of the code.
11. The *name of the jurisdiction* should be inserted in the fifth line of *Section M-904.1* on Page 217 of the code.
12. The *dollar amount* should be inserted in the tenth line of *Section M-1117.1* on Page 251 of the code.

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PREFACE

The *Basic Mechanical Code* was initially prepared and updated on the premise that adequate code requirements are essential to the safe installation and maintenance of all mechanical equipment in order to protect the public safety, health, and welfare.

The *Basic Mechanical Code* sets forth comprehensive regulations for the safe installation and maintenance of mechanical facilities where great reliance was previously placed on accepted practice and engineering standards. By establishing the end result to be accomplished rather than the method to be followed, the *Basic Mechanical Code* allows freedom and flexibility in the development of mechanical systems. It accepts nationally recognized standards as the criteria for determining the performance of materials and systems of construction.

This code, as are the other *Basic Codes* published by Building Officials and Code Administrators International, Inc., is kept up to date through the review of changes proposed by code enforcement officials, industry and design professionals, and other interested persons and organizations. Changes approved by BOCA's active membership are published in supplements to the code, and completely new editions, such as this, are prepared every three years, containing all approved changes since the previous edition.

This second edition presents the *Basic Mechanical Code* as originally issued with changes through 1974 and with certain editorial changes made to maintain the sequence of the code, to correct obvious errors, and to update the references to standards. The second edition of the *Basic Mechanical Code* is the product of many meetings and much correspondence on the part of the Basic Mechanical Code Committee, whose members gave freely of their time to develop and maintain this code. It is also the result of input from code administrators and others concerned with effective code regulation and enforcement.

Use of the *Basic Mechanical Code* or any of the other BOCA *Basic Codes* within a government jurisdiction may be accomplished only through *adoption by reference* in a proceeding of the jurisdiction's board, council, or other authoritative governing body. At the time of adoption, jurisdictions should insert the appropriate information in those passages of a code requiring specific local information, such as the date of adoption, name of adopting jurisdiction, dollar amount of fines and permit costs, etc. These passages are shown in bracketed italics in the codes, and are also listed on the copyright page of each code for which the local adoption information is required. In addition, jurisdictions may amend or modify *Basic Code* provisions to accomplish desired local requirements, although use of the codes in substantially original and standardized form is encouraged by the BOCA organization. Sample drafts of adopting ordinances for each of the BOCA *Basic Codes* are available free of charge upon request to BOCA International.

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Appendix D WATER SPRINKLER SYSTEMS WITH BASIC COMPONENTS

EDITORIAL CHANGES–THIRD PRINTING

1. Various references to *municipality* contained in the provisions of this code have been changed to read *jurisdiction*.

pp. 12, 21 and 23, Section M-201.1: Several references to boilers under General Definitions have been altered or deleted. The definition of *Boiler* in the *Basic Mechanical Code/75* has been replaced with the fuller definition of *Boiler* found in the *Basic Building Code/75*. Deleted are the following definitions: p. 12, *Boiler, heating (low pressure);* p. 21, *High pressure (and temperature);* and p. 23, *Low pressure (and temperature).*

pg. 35, Section M-301.11: listing of fire damper locations now corresponds to wording found in *Section 1808.2* of the BOCA *Basic Building Code/1975.*

pg. 106, Section M-500.4: last line now reads . . . ing official or authorized *jurisdictional* agency *(see Section M-423.4).*

pg. 124, Section M-612.4: last line now reads . . . code *(see Section M-309.0).*

pg. 158, Section M-717.2.2: second line now reads . . . structed *of* combustible material shall be guarded at the point of passage

pg. 158, Section M-717.2.2: line five now reads . . . ators, four (4) inches larger in diameter than the vent pipe, unless

pg. 202, Section M-902.2.2: fourth line now reads . . . vertical *direction.* The length of gas travel at nine (9) feet per second shall

pg. 229, Section M-1003.21: line three in item eight now reads . . . and *Section M-1011.6.*

ARTICLE 1

ADMINISTRATION AND ENFORCEMENT

SECTION M-100.0 SCOPE

M-100.1 General: The design and installation of mechanical systems, including heating systems, ventilating systems, cooling systems, steam and hot water heating systems, process piping, boilers and pressure vessels, appliances utilizing gas, liquid or solid fuel, chimneys and vents, mechanical refrigeration systems, fireplaces, barbecues, incinerators, crematories, fire protection systems and air pollution control systems shall comply with the requirements of this code.

M-100.2 Not included: Installation of plumbing systems, as defined in the plumbing code, are not covered by the provisions of this code.

M-100.3 Title: This code shall be known as the Mechanical Code of [*name of jurisdiction*] hereinafter referred to as the mechanical code or "this code."

M-100.4 Code remedial: This code shall be construed liberally and justly to insure public health, safety, and welfare insofar as they are affected by the installation and maintenance of mechanical systems.

SECTION M-101.0 PURPOSE AND INTENT

M-101.1 General: It is the purpose and intent of this code to establish minimum standards in terms of performance objectives, implemented by specific requirements, which will provide reasonable safeguards to protect the public health and safety against the hazards of inadequate, defective or unsafe mechanical installations.

SECTION M-102.0 EFFECTIVE DATE

M-102.1 General: This code shall take effect on [*date*].

SECTION M-103.0 MAINTENANCE

M-103.1 General: All mechanical systems both existing and new, and all parts thereof, shall be maintained in a safe condition. All devices or safeguards which are required by this code shall be maintained in good working order. The owner or his designated agent shall be responsible for the maintenance of mechanical systems.

SECTION M-104.0 MATTER COVERED

M-104.1 General: The provisions of this code shall apply to the mechanical installations in all buildings and structures and their appurtenant constructions.

SECTION M-105.0 VALIDITY OF OTHER REGULATIONS

M-105.1 General: Nothing in this code shall be construed to prevent the enforcement of other ordinances or local regulations which prescribe mechanical standards other than are provided herein.

SECTION M-106.0 PARTIAL INVALIDITY

M-106.1 General: If any article, term, part, provision, section, subdivision or paragraph of this code shall be held unconstitutional, invalid, or ineffective, in whole or in part by any court of competent jurisdiction, such determination shall be deemed to invalidate only the article, sections, terms, provisions, subdivisions, paragraphs or parts thereof affected, and it shall be presumed that this code would have been adopted without such invalid portion, and that every other article, term, section, subdivision, paragraph, provision or part of this code shall be deemed valid and shall continue in full force and effect.

SECTION M-107.0 UNLAWFUL ACTS

M-107.1 General: It shall be unlawful to install, extend, alter, repair or maintain mechanical systems in or adjacent to buildings except in conformity with this code.

SECTION M-108.0 ADOPTION BY REFERENCE

M-108.1 General: All of the nationally recognized standards appearing in the text and appendices of this code are hereby adopted by reference and incorporated into this code to the extent and with the limitations set upon them in the specific sections wherein they are applicable. All portions of mechanical systems installed and maintained in accordance with the regulations, specifications and standards listed in Appendix A, Accredited Authoritative Agencies, Appendix B, Accepted Engineering Practice, and Appendix C, Material and Test Standards, shall be material, equipment, system or method of construction therein specified and shall be deemed to meet the purpose and intent of this code.

SECTION M-109.0 NEW MECHANICAL SYSTEMS

M-109.1 General: This code shall apply to mechanical systems and to parts thereof which are hereafter installed in buildings of the occupancy and use group classifications as defined by the building code.

SECTION M-110.0 INSTALLATION OR REPAIRS AFFECTING BUILDING STRUCTURES

M-110.1 General: When installation or repair of any system regulated by this code affects the building structure, proper structural elements or other supports conforming to the applicable provisions of the building code shall be installed.

SECTION M-111.0 EXISTING MECHANICAL SYSTEMS

M-111.1 General: This code shall also apply to the following existing mechanical systems described in this section as if hereafter installed:

1. mechanical systems in a building occupied for occupancies or uses other than those for which it was occupied at the time this code became applicable; and
2. mechanical systems in a building moved within jurisdictional limits subject to this code.

M-111.2 Addition or alteration: Additions or alterations to existing mechanical systems shall be subject to the provisions of this code as described below.

1. Any addition or alteration, regardless of cost, made to a mechanical system shall be made in conformity with applicable regulations of this code.
2. Where additions or alterations subject parts of existing systems to loads exceeding those permited herein, such parts shall be made to comply with this code.

M-111.3 Minor repairs or replacements: Minor repairs or replacements of any existing system may be made in the same manner and arrangement as in the existing system, provided such repairs or replacements are made in a safe manner and are approved by the administrative authority.

M-111.4 Existing uses continued: Except as otherwise provided in this article and Article 11, nothing in this code shall require the removal, alteration or abandonment of, nor prevent continued use of, an existing mechanical system.

SECTION M-112.0 PERMITS FOR MECHANICAL WORK

M-112.1 Permits required: Mechanical work shall not be commenced until a permit for such work has been issued by the administrative authority. A mechanical permit shall not be transferrable.

M-112.2 Permits not required: Permits shall not be required for the following:

1. any portable heating appliance;
2. any portable ventilation equipment;
3. any portable cooling unit;
4. any steam, hot or chilled water piping within any heating or cooling equipment regulated by this code;
5. replacement of any part which does not alter its approval or make it unsafe;
6. any portable evaporative cooler, and
7. any self-contained refrigerating system containing ten (10) pounds or less of refrigerant or actuated by motors of one (1) horsepower or less.

M-112.3 Applications for mechanical permits: Application for a permit for mechanical work shall be made on forms prepared and provided by the administrative authority and shall be accompanied by an adequate description of the proposed mechanical work, plans and specifications, and the application fee established by the administrative authority.

M-112.4 Denial of permit: If a permit is denied, written notice of the reasons for denial shall be provided to the applicant who may submit such revised plans and specifications as are necessary to obtain a permit.

M-112.5 Time limitation on permits: Every permit issued by the administrative authority under the provisions of this code shall expire by limitation and become null and void if the work authorized by such permit is not commenced within six (6) months from the date of issuance of such permit, or if the work authorized by such permit is suspended or abandoned at any time after the work is commenced for a period of six (6) months. Before such work can be recommenced, a new permit shall be obtained.

SECTION M-113.0 REQUIREMENTS FOR PERMITS

M-113.1 Plans required: The administrative authority shall require the submission and approval of plans and specifications in duplicate showing the nature and extent of the proposed work before a permit is issued. If, in the course of the work, it is found necessary to make any change from the approved plans and specifications on which a permit has been issued, amended plans and specifications shall be submitted and, if approved, a supplementary permit shall be issued to cover the change after the same conditions required to secure the original permit have been satisfied.

M-113.2 Types of plans: Plans and specifications required by the administrative authority in Section M-112.0 shall show the following:

1. **layout for each floor with dimensions of all working spaces and a legend of all symbols used;**

2. location, size and material of all piping;
3. location, size and materials of all air ducts, air inlets and air outlets;
4. rated capacity in horsepower of all boilers, warm air furnaces, heat exchangers, blower fans, refrigerant compressors and absorption units;
5. location, size and material of all vents and chimneys;
6. location and area of all ventilation and combustion air openings and ducts;
7. location of all air shutters, fire dampers and fireresistance rated walls with the hourly rating of the fireresistance rated wall noted thereon;
8. the first sheet of each set of plans and specifications shall show the address of the proposed work, the name and address of the owner or lessee of the premises and the name, address and seal of the designer; and
9. plans and specifications shall be of sufficient clarity to show that the proposed installation will conform to the provisions of this code and of all applicable laws, ordinances, rules and regulations of this jurisdiction. When the plans and specifications do not comply with provisions of this code, the necessary changes or revisions shall be made thereto prior to the issuance of the mechanical permit.

M-113.3 Examination of plans: All plans and specifications required to be submitted shall be examined by the administrative authority to determine conformance with the provisions of this code after the application has been filed and the application fee paid in accordance with Section M-112.3.

When plans and specifications of unusual designs or magnitude of construction are filed, the administrative authority may refer such plans and specifications to Building Officials and Code Administrators International for advice and recommendations as to their safety of design and compliance with this code.

M-113.4 Approval in part: Nothing in this section shall be construed to prevent the administrative authority from issuing a permit for the installation of part of a mechanical system before the entire plans and specifications of said system have been submitted or approved, if adequate information and detailed statements have been presented for the same and have been found to comply with this code.

SECTION M-114.0 FEES

M-114.1 General: A permit to begin work for new construction or alteration shall not be issued until the application fee and permit fee prescribed have been paid, nor shall an amendment to a permit necessitating an additional fee because of the additional work involved be issued until the additional fee shall have been paid.

SECTION M-115.0 INSPECTIONS

M-115.1 General: All equipment for which a permit is obtained under this code shall be inspected or approved by the administrative authority. Any portion of equipment intended to be concealed by any permanent portion of the building shall not be concealed until inspected and approved by the administrative authority. When installation of any equipment is complete, a final inspection shall be made. Equipment regulated by this code shall not be connected to the fuel or power supply and placed in normal operation until it complies with all applicable requirements of this code, and a final inspection has been completed.

A final inspection approval may, upon notice, be revoked by the administrative authority if it is found that the heating, cooling or refrigeration equipment fails in any respect to comply with the requirements of this code, or that the installation is unsafe, dangerous or a hazard to life. The administrative authority may accept inspection certification reports from an approved quality control and inspection agency, in lieu of on-site inspection when on-site inspection is impractical.

Exception: The requirement of this section shall not be considered to prohibit the operation of any heating equipment installed to replace existing heating equipment serving an occupied portion of a building in the event a request for inspection of such heating equipment has been filed with the department not more than forty-eight (48) hours after such replacement work is completed, and before any portion of such equipment is concealed by any permanent portion of the building.

SECTION M-116.0 CREDENTIALS REQUIRED

M-116.1 General: The administrative authority or his authorized representative shall carry proper credentials of his respective office for the purpose of inspecting any and all buildings and premises in the performance of his duties under this code during usual business hours.

SECTION M-117.0 CONDEMNATION PROCEDURES

M-117.1 General: The administrative authority shall condemn any mechanical material or equipment which is worn, damaged, defective, or constructed as to constitute a safety hazard, and such condemned material or equipment shall not be reused in mechanical systems.

SECTION M-116.0 VIOLATIONS

M-118.1 General: Written notice of any violation of this code shall be given any violator thereof, and upon his failure to remove the violation within a reasonable time, but not more than seven (7) days, prosecution for violation of this code shall be commenced against him.

SECTION M-119.0 MEANS OF APPEAL

M-119.1 Application for appeal: The owner of a building or structure or any other person may appeal a decision of the building official refusing to grant a modification of the provisions of this code covering the manner of construction or materials to be used in the erection, alteration or repair of a mechanical system to the board of appeals. Application for appeal may be made when it is claimed that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply, or an equally good or better form of construction can be used.

M-119.2 Appeals procedure

M-119.2.1 Notice of meetings: The board shall meet upon notice of the chairman within ten (10) days of the filing of an appeal or at stated periodic meetings if warranted by the volume of work.

M-119.2.2 Public hearing: All hearings shall be public, and the appellant, his representative, the official of the jurisdiction and any other person whose interests may be affected by the matter on appeal shall be given an opportunity to be heard.

M-119.2.3 Adjourned meeting: When five (5) qualified members are not present to consider a specific appeal, either the appellant, the building official or their representatives may request a postponement of the hearing.

M-119.3 Decision of board of appeals

M-119.3.1 Action of board: The board shall affirm, modify or reverse the decision of the building official by a concurring vote of three (3) members.

M-119.3.2 Resolutions of board: Every action of the board shall be by resolution, and certified copies shall be furnished to the appellant and to the building official.

M-119.3.3 Determining vote: Failure to secure three (3) concurring votes shall be deemed a confirmation of the decision of the building official, except that the appellant shall be entitled to further hearing before a full board if there were not five (5) qualified members present when the vote was taken.

M-119.3.4 Enforcement of decision: The building official shall take immediate action in accordance with the decision of the board.

M-119.4 Court review: Any person aggrieved by a decision of the board of appeals, whether or not a previous party to the decision, or any municipal officer or official board of the jurisdiction may apply to the appropriate court for a writ of certiorari to correct errors of law in such decisions. Application for review shall be made to the proper court of jurisdiction within fifteen (15) days after the filing of the board's decision in the office of the building official.

SECTION M-120.0 APPROVALS OF NEW SYSTEMS

M-120.1 General: The provisions of this code are not intended to prevent the use of any material or method of construction not specifically prescribed by this code, provided any such alternate has been approved. The building official may approve any such alternate provided he finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fireresistance rating durability and safety. The building official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use, or he may accept duly authenticated reports from Building Officials and Code Administrators International or from recognized authoritative sources of all new materials and systems proposed for use.

ARTICLE 2

DEFINITIONS

SECTION M-200.0 GENERAL

M-200.1 Scope: Unless otherwise expressly stated, the following terms listed in Section M-201.0 shall, for the purpose of this code, have the meanings indicated in this article.

M-200.2 Interchangeability: Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural the singular.

M-200.3 Terms defined in building code: Where terms are not defined in this section and are defined in the building code, they shall have the meanings ascribed to them as in the building code.

M-200.4 Terms not defined: Where terms are not defined under the provisions of this code or under the provisions of the building code, they shall have ascribed to them their ordinary accepted meanings such as the context herein may imply.

SECTION M-201.0 GENERAL DEFINITIONS

Absorber (adsorber): See Section M-801.0.

Absorption (adsorption) system: See Section M-801.0.

Administrative authority: The individual official, board, department or agency established and authorized by a state, county, city or other political subdivision created by law to administer and enforce the provisions of the mechanical code.

Air: All air supplied to mechanical equipment for combustion, ventilation, cooling, etc. Standard air is air at standard temperature and pressure, namely seventy (70) degrees F. and twenty-nine and ninety-two one-hundredths (29.92) inches of mercury.

Air, excess: The air remaining after a fuel has been completely burned, or that air supplied in addition to the theoretical quantity required for combustion.

Air, primary: Any air which is mixed with the fuel at or in the burner or fuel bed, for the purpose of promoting combustion of the fuel or combustible materials (see "Air for combustion").

Air, secondary: Any air brought in around the burner or through openings in the combustion chamber for the purpose of completing combustion.

Air, theoretical: The exact amount of air required to supply oxygen for complete combustion of a given quantity of a specific fuel.

Air, underfire: Any air controlled with respect to quantity and direction, forced or induced, supplied beneath the grate that passes through the fuel bed.

Air conditioning: The treatment of air so as to control simultaneously its temperature, humidity, cleanness and distribution to meet the requirements of a conditioned space.

Air conditioning system: An air conditioning system consists of heat exchangers, blowers, filters, supply, exhaust and return ducts and shall include any apparatus installed in connection therewith.

Air gap (drainage system): The unobstructed vertical distance through the free atmosphere between a waste pipe outlet and the flood level rim of the receptacle into which it is discharging.

Air gap (water distribution system): The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a fixture and the flood level rim of the receptacle.

Air for combustion: The amount of air required for safe and proper combustion at the altitude of [*name of jurisdiction*] (see also "Air, primary").

Air pollutants: Any particulate matter, gas or odor, including (but not limited to) smoke, dust, soot, vapor, mist, or irritating, noxious, or obnoxious acids, alkalies, fumes, or gases, or any combination of these. Uncombined water vapor is not an air pollutant.

Air pollution: The presence in the out-of-doors atmosphere of one (1) or more air pollutants in such quantities as to be, or tend to be, injurious to human, plant or animal life, or to property, or as to interfere unreasonably with the enjoyment of life and property.

Air shutter: An adjustable device for varying the effective opening of the air inlets or inlet.

Appliance (mechanical): A device or apparatus, including any attachments or apparatus designed to be attached, manufactured and designed to use electricity, natural gas, manufactured gas, mixed gas, liquified petroleum products, solid fuel, oil, or any gas as a fuel for heating, cooling or developing light or power.

Appliance, approved: An appliance accepted or acceptable under an applicable nationally recognized standard accepted as suitable for the proposed use under procedures and powers of the administrative authority, or accepted by a nationally recognized testing or inspection agency (see Appendices A and B).

Appliance, unvented: An appliance designed or installed in such a manner that the products of combustion are not conveyed by a vent or chimney directly to the outside atmosphere.

Appliance, vented: An appliance designed and installed in such a manner that all the products of combustion are conveyed directly from the appliance to the outside atmosphere through an approved chimney or venting system.

Approved: Approved by the building official or other authority having jurisdiction.

Atmosphere: The air which envelops the earth.

Automatic detecting device: See Section M-1001.0.

Automatic fire alarm system: See Section M-1001.0.

Automatic safety pilot: See "Flame safeguard."

Automatic sprinkler(s): See Section M-1001.0.

Automatic sprinkler system: See Section M-1001.0.

Automatic water supply: See Section M-1001.0.

Auxiliary fuel-firing equipment (incinerator): Equipment to supply additional heat, by the combustion of an auxiliary fuel, for the purpose of attaining temperatures sufficiently high:

1. to dry and ignite the waste material;
2. to maintain ignition thereof, and
3. to promote complete combustion of combustible solids, vapors and gases.

Backflow: The flow of water or other liquids, mixtures or substances into the distributing piping system of potable water from any source other than its intended source. Back-siphonage is one type of backflow.

Backflow preventor: Device or means to prevent backflow.

1. **Atmospheric type (vacuum breaker, atmospheric):** A device designed for installation in a water line (without any control valves downstream) to close against its inlet seat and introduce air into its outlet side when water ceases to flow through it.
2. **Pressure type (vacuum breaker, pressure):** A device designed for installation in a water line to close against its inlet seat and introduce air into its outlet side when inlet water pressure drops below the outlet water pressure.

3. **Reduced pressure zone type:** An assembly of differential valves and check valves including an automatically opened spillage port to the atmosphere.

Back-siphonage: The flowing back of used, contaminated or polluted water from a plumbing fixture, or other source, into a potable water supply pipe due to a negative gauge pressure in such pipe.

Baffle: Any construction intended to change the direction of flow of the products of combustion.

Boiler: A closed heating appliance intended to supply hot water or steam for space heating, processing or power purposes.

Low pressure and temperature

Steam: Any boiler, generator, pressure vessel, system, piping or steam equipment used for the purpose of heating or distributing steam for heating, power or processing, operating at pressure of fifteen (15) pounds per square inch gauge (psig) or less, shall be classed as low pressure.

Hot water: Any boiler, generator, pressure vessel, system, piping or equipment used for the purpose of heating or distributing hot water for heating, supply or processing, operating at pressure not exceeding one hundred sixty (160) psig and temperatures not exceeding two hundred fifty (250) degrees F., shall be classed as low pressure.

Exception: Hot water supply boilers equipped with safety devices as required by the mechanical code listed in Appendix B and direct fired are considered outside the scope of this definition when the heat input is less than two hundred thousand (200,000) Btus per hour, the water temperature is less than two hundred (200) degrees F. and the capacity is less than one hundred twenty (120) gallons.

High pressure and temperature

Steam: Any boiler, generator, pressure vessel, system, piping or equipment used for the purpose of heating or distributing steam for heating, power and processing, operating at pressure in excess of fifteen (15) psig, shall be classed as high pressure.

Hot water: Any boiler, generator, pressure vessel, system, piping or equipment used for the purpose of heating or distributing hot water for heating or processing, operating at pressures in excess of one hundred sixty (160) psig or temperatures in excess of two hundred fifty (250) degrees F., shall be classed as high pressure.

Boiler, automatically controlled fuel supply: A boiler in which fuel to the main burner is normally turned on automatically.

Boiler controls

1. **Input control valve:** An automatic fuel control valve for regulating boiler input.
2. **"On" and "off" type control:** A boiler input control valve that regulates the main fuel supply to either the open or the closed position.
3. **Safety shut-off valve:** An automatic fuel control valve of the "on" and "off" type that is actuated by the safety control system or by an emergency device.
4. **Throttling type control:** A boiler input control valve that regulates the main fuel supply throughout the entire range from the open to the closed position.

Boiler room: Any room where a boiler is located. This equipment may be producing hot water or steam. For the purposes of this code, this definition shall not include rooms containing domestic type water heaters of less than one hundred (100) gallons storage capacity or rooms containing boilers in one- and two-family residential occupancies (see also "Furnace room" and "Mechanical equipment room").

Bonding mortars, air setting: Those bonding mortars which take a rigid set when dried. They are prepared from suitable refractory materials by proper selection and combination. Chemical binders impart air-setting properties and maintain the strength of the bond up to the temperature at which the ceramic bond takes effect. Air-setting mortars form mechanically strong joints with high resistance to abrasion and erosion. The mortar shall bond the wall the whole way through from the hot to the cold surface.

Brazed joint: A gas-tight joint obtained by the joining of metal parts and metallic alloys which melt at temperatures higher than one thousand (1,000) degrees F as determined in an approved manner (see "Soldered joint").

Breeching (flue connection): A passage for conducting the products of combustion from a fuel-fired appliance to the vent or chimney (see also "Chimney connector" and "Vent connector").

Bridge wall: A partition wall between chambers over which pass the products of combustion.

Brine: A liquid, used for the transmission of heat without a change in its state, not having a flash point, or a flash point above one hundred fifty (150) degrees F. as determined by the ASTM D 93 standard listed in Appendix C.

British thermal unit: The quantity of heat required to raise one (1) pound of water one (1) degree Fahrenheit, usually abbreviated B.T.U., BTU or Btu.

Building code: The building code officially adopted by the legislative body of this jurisdiction or such other code as may be officially designated by the legislative body of this jurisdiction for the regulation of the construction, alteration, addition, repair, removal, demolition, use, location, occupancy and maintenance of buildings or structures.

Building official: The officer or other designated authority charged with the administration and enforcement of this code, or his duly authorized representative.

Building use group classifications: The arrangement of buildings in classes according to use and occupancy.

Burner: A device for the final conveyance of the fuel or a mixture of fuel and air to the combustion zone.

Burner, gas valve: A manually or mechanically operated valve which controls the flow of gas to the main burner.

Burning area: The horizontal projected area of grate, hearth, or combination thereof, on which active burning takes place.

Burning rate (incinerator): The amount of waste incinerated, usually expressed in pounds per hour per square foot of burning.

Capacity (incinerator): The amount of waste incinerated, usually expressed in pounds per hour with the characteristics or type of waste stipulated.

Casing: The jacket of a heating or cooling unit.

Checkerwork: A pattern of multiple openings in refractory through which the products of combustion pass to promote turbulent mixing of the gases.

Chimney: A primarily vertical enclosure containing one (1) or more passageways.

1. **Chimney, residential appliance type:** An approved chimney for removing products of combustion from a residential type appliance producing combustion gases not in excess of one thousand (1,000) degrees F. measured at the appliance flue outlet.
2. **Chimney, building heating appliances:** An approved chimney for removing products of combustion from fuel-burning and electric boilers operating at not over fifty (50) psig pressure, central furnaces and heaters intended primarily for heating spaces having a volume exceeding twenty-five thousand (25,000) cubic feet.
3. **Chimney, low-heat appliance type:** An approved chimney for removing the products of combustion from fuel-burning, low-heat appliances producing combustion gases not in excess of one thousand (1,000) degrees F. under normal operating conditions but capable of producing combustion gases of fourteen hundred (1400) degrees F. during intermittent forced firing for periods up to one

(1) hour. All temperatures shall be measured at the appliance flue outlet.

4. **Chimney, medium-heat appliance type:** An approved chimney for removing the products of combustion from fuel-burning, medium-heat appliances producing combustion gases not in excess of two thousand (2,000) degrees F. measured at the appliance flue outlet.
5. **Chimney, high-heat appliance type:** An approved chimney for removing the products of combustion from fuel-burning, high-heat appliances producing combustion gases in excess of two thousand (2,000) degrees F. measured at the appliance fuel outlet.

Chimney connector: A pipe which connects a fuel burning appliance to a chimney (see "Breeching").

Chimney, factory-built: A chimney that is factory-made and listed by a nationally recognized testing or inspection agency for venting gas appliances, gas incinerators and solid or liquid fuel-burning appliances.

Chimney liner: The lining material of approved fire clay or other approved material.

Chimney masonry: A field-constructed chimney of solid masonry units, bricks, stones, listed hollow masonry units or reinforced concrete built in accordance with nationally recognized standards.

Chimney, metal: Field-constructed chimney made of metal and built in accordance with nationally recognized standards.

Code: These regulations, subsequent amendments thereto or any emergency rule or regulation which the administrative authority having jurisdiction has lawfully adopted.

Combustible material: Any material not defined as noncombustible.

Combustion: As used herein, refers to the rapid oxidation of fuel accompanied by the production of heat or heat and light.

Combustion air: See "Air for combustion".

Combustion chamber: The space in a heating appliance provided for the combustion of fuel.

Combustion chamber, primary (incinerator): Chamber within an incinerator where primary ignition and burning of the waste occur.

Combustion chamber, secondary (incinerator): Chamber where unburned combustible materials from primary chamber are completely burned.

Companion or block valves: See Section M-801.0.

Compressor: See Section M-801.0.

Compressor unit: See Section M-801.0.

Condensate: The liquid which separates from a gas (including flue gases) due to a reduction in temperature.

Condenser: See Section M-801.0.

Condenser coil: See Section M-801.0.

Condensing unit: See Section M-801.0.

Container: See Section M-801.0.

Connection to water supply system: Connection to water supply system shall not be construed to include connections to existing faucet.

Continuous pilot: A pilot that operates at all times regardless of whether the main burner is on or off.

Control, high limit: A device responsive to change in temperature and used for the purpose of interrupting the fuel supply when plenum or bonnet temperature exceeds predetermined settings.

Control, safety pilot: A device provided to shut off automatically the fuel supply to the main burner when the means of ignition of such fuel supply becomes inoperative.

Conversion burner: A burner provided to convert a heating appliance from its designed fuel to a different fuel.

Critical pressure, critical temperature and critical volume: See Section M-801.0.

Crawl space: A space located under the first floor of a building or structure with headroom of less than five (5) feet.

Curtain wall (incinerator): A partition wall between chambers under which pass the products of combustion.

Damper: A manually or automatically controlled device to regulate draft or the rate of flow of air or combustion gases.

1. **Backdraft damper (shutter):** A device which, when mounted in a duct or opening, permits the flow of air in one (1) direction only. It is normally opened by the energy of the air stream but may be opened and/or closed by external mechanical means.
2. **Barometric:** See "Draft regulator."
3. **Butterfly:** A plate or blade installed in a duct, breeching or flue connection which rotates on an axis.
4. **Guillotine:** An adjustable blade installed vertically in a breeching or flue connection usually counter-balanced for easy operation.
5. **Sliding:** An adjustable blade installed in a duct, breeching or flue connection.

Deluge system: See Section M-1001.0.

Department: The department of [*name of jurisdiction*] or the chief administrative officer thereof responsible for the enforcement of this code or his representative.

Department having jurisdiction: See "Administrative authority."

Department store: The entire space occupied by one (1) tenant or more than one (1) tenant in an individual store where more than one hundred (100) persons commonly assemble on other than the street-level floor for the purpose of buying personal wearables and other merchandise.

Design working pressure: The maximum allowable working pressure, psig, for which a specific part of a system is designed.

Destructor: An incinerator meeting the requirements of Class III, Class IV, Class VI or Class VII incinerators.

Detached incinerator: Any incinerator outside of a building.

Direct system: See Section M-801.0.

Double direct system: See Section M-801.0.

Double indirect vented open-spray system: See Section M-801.0.

Down-pass: A gas passage placed between two (2) chambers of an incinerator to carry the products of combustion in a downward direction.

Draft: The pressure difference existing between the equipment or any component part and the atmosphere which causes a continuous flow of air and products of combustion through the gas passages of the appliance to the atmosphere.

1. **Forced draft:** The pressure difference created by the action of a fan, blower or ejector which supplies the primary combustion air above atmospheric pressure.
2. **Induced draft:** The pressure difference created by the action of a fan, blower or ejector which is located between the appliance and the chimney or vent termination.
3. **Natural draft:** The pressure difference created by a vent or chimney due to its height and the temperature difference between the flue gases and the atmosphere.

Draft hood: A device built into a gas appliance or made a part of a chimney connector or vent connector from a gas appliance which is designed to:

1. permit the ready escape of flue gases in the event of zero draft, a back-draft or stoppage in the vent beyond the draft hood;
2. permit the ready relief of the back pressure from a back-draft so it does not enter the gas appliance, and
3. neutralize the possible effects of excess draft (stack action) upon the operation of the appliance.

Draft regulator: A device to admit air to the breeching or flue connection thereby automatically maintaining a constant draft in the equipment. See also "Damper."

Drip: The container placed at a low point in a system of piping to collect condensate and from which it may be removed.

Drop arch: Any vertical refractory wall supported by arch construction.

Dry chemical extinguishing system: See Section M-1001.0.

Drying hearth: A surface within the primary chamber upon which wet waste material is deposited for drying prior to burning.

Duct: A tube or conduit used for conveying or encasing purposes as specifically listed below.

1. **Air duct:** A tube or conduit used for conveying air. The air passages of self-contained systems are not to be construed as air ducts.
2. **Pipe duct:** A tube or conduit used for encasing pipe.
3. **Wire duct:** A tube or conduit used for encasing either moving or stationary wire, rope, etc.

Duct riser: A duct which extends vertically one (1) full story or more.

Dwelling unit: One (1) or more rooms arranged for the use of one (1) or more individuals living together as a single housekeeping unit with cooking, living, sanitary and sleeping facilities.

Effective opening: The minimum cross-sectional area at the point of water-supply discharge, measured or expressed in terms of (1) the diameter of a circle, or (2) if the opening is not circular, the diameter of a circle of equivalent cross-sectional area.

Electric space heaters, portable: Heaters not intended for permanent connection to a structure or electric wiring and which are usually provided with a cord and plug.

Electric space heaters, stationary: Heaters permanently mounted in a structure and which are permanently connected to its electric wiring.

Emission: The discharge or escape into the atmosphere of one (1) or more air pollutants.

Entrance: A confined passageway immediately adjacent to the door through which people enter a building.

Evaporator: See Section M-801.0.

Evaporator coil: See Section M-801.0.

Exhaust system: An assembly of connected ducts, plenums, fittings, registers, grilles and hoods through which air is conducted from the space or spaces and exhausted to the outside atmosphere.

Existing work: A mechanical system or any part thereof installed prior to the effective date of this code.

Exitway (exit): That portion of a means of egress which is separated from all other spaces of a building or structure by construction or equipment as required in the building code to provide a protected way of travel to the exitway discharge.

Expansion coil: An evaporator constructed of pipe or tubing.

Expansion or settling chamber: Any chamber designed to reduce the velocity of the products of combustion to promote the settling of fly ash from the gas stream.

Field test: See Section M-801.0.

Fillet weld: A weld of approximately triangular cross-section joining two (2) surfaces approximately at right angles to each other in a lap joint, tee joint or corner joint.

Filter, air: A device designed to remove solids from the heating, cooling or ventilating air.

Fire alarm system: See Section M-1000.0.

Fire damper: An approved automatic, or self-closing, noncombustible barrier designed to prevent the passage of air, gases, smoke or fire through an opening, a duct or plenum chamber.

Fire department: The fire department of *[name of jurisdiction]*.

Fire department connection: See Section M-1001.0.

Fire protection system: See Section M-1001.0.

Fire suppression system: See Section M-1001.0.

Firebrick: An approved refractory brick.

Firebrick, high heat duty: Refractory firebrick clay which meets the standards of this code.

Flame safeguard: A device which will automatically shut off the fuel supply to a main burner or group of burners when the means of ignition of such burners become inoperative.

Flue connection (breeching): A passage for conducting the products of combustion from a fuel-fired appliance to the vent or chimney (see also "Chimney connector" and "Vent connector").

Flue gases: Products of combustion and excess air.

Fly ash: Suspended particulate matter in products of combustion.

Fly ash collector: Auxiliary equipment designed to remove fly ash in dry form from the products of combustion.

Foam extinguishing system: See Section M-1001.0.

Fuel: Combustible substance or material or any combination of such.

Furnace: A completely self-contained fuel-fired heating unit with burners, combustion chamber, heat exchanger and casing.

Furnace, attic: A forced warm-air furnace designed and approved specifically for installation in an attic, normally unoccupied.

Furnace, central: A self-contained fuel-fired furnace intended primarily to supply heated air through ducts.

Furnace, downflow (counterflow): A forced warm-air furnace designed with air flow through the furnace essentially in a vertical path downward, discharging air at or near the bottom of the furnace.

Furnace, duct: A furnace designed for installation in a duct of an air distribution system. Air circulation is provided by a blower not furnished as an integral part of the furnace.

Furnace, floor: A self-contained connected or vented furnace designed to be suspended from the floor of the space being heated, taking air for combustion outside this heated space and with a means for observing flame and lighting the appliance from the space being heated.

Furnace, forced warm air: A furnace equipped with a blower to provide the primary means for circulating air.

Furnace, gravity: A furnace which depends on the difference of the density of warm and cool air for circulation.

Furnace, pipeless: A gravity furnace in which the entire heat output is delivered through one (1) opening directly above the combustion chamber. Return air enters the unit through grille work around the perimeter of the output grille.

Furnace room: A room primarily used for the installation of fuel-fired heating equipment other than boilers (see also "Boiler room" and "Mechanical equipment room").

Fusible link: A safety device designed to melt, separate or release at a predetermined temperature.

Fusible plug: A device having a predetermined temperature fusible member for the relief of pressure.

Fusion joint: The melting together of filler metal and base metal, or of base metal only, which results in coalescence.

Gas: An aeroform fluid, having neither independent shape nor volume, which has weight, occupies space, tends to expand indefinitely, and which can be changed to a liquid or a solid state only by increasing pressure with decreased or controlled temperature or by decreasing temperature with increased or controlled pressure. The word shall include natural, manufactured, mixed gas or liquefied petroleum products with Btu content based on the altitude of *[name of jurisdiction]*.

Gas, control (automatic): An automatic device, consisting essentially of a gas valve for controlling the main gas supply to an appliance.

Gas, house piping: House gas piping means the system of piping within a structure or a building, either exposed or concealed, which conveys gas from the outlet of the service meter or line to appliances at various places throughout the building. Any piping underground which contains measured gas is also house piping.

Gas outlet: A threaded connection in a house gas piping system to which a gas-burning appliance is or may be attached.

Gas ranges and plates: Gas-fired units used for domestic and commercial cooking and/or heating of food.

Gas washer or scrubber: Auxiliary equipment designed to remove pollutants in wet form from the products of combustion.

Generator: See Section M-801.0.

Grade (ground level): A reference plane representing the average of finished ground level adjoining the building at all exterior walls.

Grate: Surface with suitable openings to support the fuel bed and permit passage of air through the burning fuel. It is usually located in the primary combustion chamber and is designed to permit removal of unburned residue and may be horizontal or inclined, stationary or movable.

Hallway: A corridor for the passage of people.

Halogenated extinguishing system: See Section M-1001.0.

Heat exchangers: A device used for the transfer of heat from one medium to another.

Heat of combustion: The heat released by combustion of a unit quantity of waste or fuel, measured in Btus.

Heat release rate: The amount of heat liberated during the process of complete combustion and expressed in Btu per hour per cubic foot of the internal combustion chamber volume.

Heater, radiant: A room heater utilizing ceramic, asbestos, clay-back or equivalent as the radiating media.

Heater, recessed: A completely self-contained heating unit usually recessed in a wall and located entirely above the floor of the space it is intended to heat.

Heater, room (space): Above-the-floor, free-standing heating unit for direct heating of the space in and adjacent to that in which the unit is located, without external heating pipes or ducts.

Heater, unit: See "Unit heater."

Heating system, central warm air: A heating system consisting of an air heating appliance from which the heated air is distributed by means of ducts, pipes or plenums and shall include any accessory apparatus and equipment installed in connection therewith.

Heating system, forced air: A central warm air heating system that is equipped with a fan or blower which provides the primary means for circulation of air.

Heating system, gravity: A central warm air heating system through which air is circulated by gravity.

Heating value: The heat released by combustion of a unit quantity of waste or fuel, measured in British Thermal Units (Btu).

High limit control: See "Control, high limit."

High side: See Section M-801.0.

Hot drying hearth: A surface upon which wet material is placed to dry by the action of the hot combustion gases that pass successively over the wet material and under the hearth.

Hot water forced circulation system: A system that has a booster or circulating pump installed to mechanically circulate the water in the piping system.

Hot water gravity system: A system that depends on the difference in the weight or difference in the density between the hot water and the cold water to create circulation within the piping system.

Humanly occupied space: A space normally frequented or occupied by people but excluding machinery rooms and walk-in coolers used primarily for refrigerated storage.

Humidifier: A device used to add moisture to the air.

Ignition pilot: A pilot that operates during the lighting cycle and discontinues during main burner operations.

Incineration: The process of igniting and burning solid, semi-solid or gaseous combustible waste to carbon dioxide and water vapors.

Incinerator, domestic gas-fired type: An approved direct-fed gas-fired type, generally located within a building or structure, and designed primarily for use in one- and two-family dwelling occupancies and for the burning of ordinary waste material with a capacity of not more than five (5) cubic feet.

Indirect closed-surface system: See Section M-801.0.

Indirect open-spray system: See Section M-801.0.

Indirect system: See Section M-801.0.

Indirect vented closed-surface system: See Section M-801.0.

Indirect waste pipe: A waste pipe which does not connect directly with a drainage system but which discharges into the drainage system through an air break or air gap, into a trap, plumbing fixture, receptor, interceptor or other approved point of disposal.

Industrial piping (power piping): All piping used for the conveying of steam, water and condensate in power houses, oil refineries, industrial plants, atomic plants or mills and mines or similar occupancy either underground, on the ground or suspended above ground, outside or inside of buildings, under low pressure or pressures to the highest limits of the piping, shall be classed as industrial piping.

Infrared radiant heater gas-fired (unvented): A self-contained heater which directs a substantial amount of its energy output in the form of infrared radiant energy into the area to be heated and discharges its products of combustion into the space being heated.

Intermittent pilot: A pilot that operates during the ignition cycle and continues during main burner operation but is shut off at other times.

Internal gross volume: See Section M-801.0.

Limit control: A device responsive to changes in pressure or temperatures or liquid level for turning on, shutting off or throttling the gas supply to an appliance.

Limited area sprinkler system: See Section M-1001.0.

Limited charge system: See Section M-801.0.

Liquid receiver: See Section M-801.0.

Listed: Listed refers to products which are shown in a list published by a nationally recognized testing or inspection agency and whose listing states that the product complies with nationally recognized safety standards (see Appendices A and B).

Lobby: A waiting room, or large hallway serving as a waiting room.

Low side: See Section M-801.0.

Lubricated plug-type valve: A valve of the plug and barrel type provided with means for maintaining a lubricant between the bearing surfaces.

Machinery: See Section M-801.0.

Machinery room: See Section M-801.0.

Makeup air: Outside air required to replace air being exhausted.

Manual fire alarm system: See Section M-1001.0.

Manual gas shut-off valve: A manually operated valve in the gas line for the purpose of completely turning on or shutting off the gas supply to the appliance.

Manufacturer: The company or organization which evidences its responsibility by affixing its name or nationally registered trademark or trade name to the equipment.

Mechanical equipment room: A room or space in which nonfuel-fired equipment is located (see also "Boiler room" and "Furnace room").

Mechanical joint: A gas-tight joint obtained by the joining of metal parts through a positive-holding mechanical construction.

Metal pipe, single wall: An unlisted sheet metal hollow cylinder used for conveying products of combustion.

Meter: The instrument installed to measure the volume of gas or liquid delivered through it.

Mixing chamber: Chamber usually placed between the primary combustion chamber and the secondary combustion chamber where thorough mixing of the products of combustion is accomplished by turbulence created by increased velocities of the gases, checkerwork and/or turns in direction of the gas flow.

Modulating (throttling): The action of a control from its maximum to minimum position in either predetermined steps or increments of movements as caused by its actuating medium.

Nationally recognized testing or inspection agency: One acceptable to the authorities having jurisdiction that provides uniform testing and examination procedures under established standards, is properly organized, equipped and qualified for testing, and has a follow-up inspection service of the current production of the listed products (see Appendix A).

Noncombustibles: Materials which pass the test procedure (for defining noncombustibility of elementary materials) set forth in ASTM E 136 listed in Appendix C of this code when exposed to a furnace temperature of thirteen hundred eighty-two (1382) degrees F. for a period of five (5) minutes, and do not cause a temperature rise of the surface or interior thermocouples in excess of fifty-four (54) degrees F. above the furnace air temperature at the beginning of the test and which do not flame after an exposure of thirty (30) seconds.

Nonpositive displacement compressor: See Section M-801.0.

Nuisance: Public nuisance as known in common law or in equity jurisprudence; whatever is dangerous to human life or detrimental to health; whatever building, structure, or premise is not sufficiently ventilated, sewered, drained, cleaned or lighted, in reference to its intended or actual use; and whatever renders the air or human food or drink or water supply unwholesome.

Occupancy sprinkler system: See Section M-1001.0.

Open-burning: Fire, except in a device approved by the administrative authority for such a purpose.

Outdoor opening: A door, window, louver or skylight openable to the outside atmosphere.

Particulate: Any suspended ash particles, soot or any material, except uncombined water, which is suspended in a gas stream as a liquid or solid at standard conditions.

P.C.E.: Pyrometric Cone Equivalent.

Person: A natural person, his heirs, executors, administrators or assigns and includes a firm, partnership or corporation, its or their successors or assigns. Singular includes plural; male includes female.

Pilot: A flame which is utilized to ignite the fuel at the main burner or burners.

Piping: See Section M-801.0.

Plenum: Air compartment or chamber to which one (1) or more ducts are connected and which forms part of an air distribution system.

Positive displacement compressor: See Section M-801.0.

Premises: The buildings and that part of the grounds of one (1) parcel of property where an installation would affect the safety of those buildings or adjacent property.

Pressure-imposing element: See Section M-801.0.

Pressure-limiting device: See Section M-801.0.

Pressure or velocity classification of duct systems and plenums

1. **Low pressure:** Static pressure in the duct or plenum of two (2) inch water column (W.C.) or less.
2. **Medium pressure:** Static pressure in the duct or plenum greater than two (2) inch W.C. up to six (6) inch W.C.
3. **High pressure:** Static pressure in the duct or plenum six (6) inch W.C. or greater up to ten (10) inch W.C.

Pressure-relief device: A pressure-actuated valve or rupture member designed to automatically relieve excessive pressure.

Pressure-relief valve: A pressure-actuated valve held closed by a spring or other means and designed to automatically relieve pressure in excess of its setting.

Proprietary (local) system: See Section M-1001.0.

Pressure vessel: See Section M-801.0.

Purge: To clear of air, water or other foreign substances.

Rating input: The amount of gas fuel in Btus per hour that can be safely burned in an appliance at the altitude of *[name of jurisdiction]*.

Rating output: The amount of heat in Btus per hour that an appliance will deliver for useful service when operating at rating input.

Receiver: See "Liquid receiver."

Receptor: A plumbing fixture which is intended to receive the discharge from indirect waste piping, is directly connected to the drainage system and is properly trapped and vented and which is installed as provided for in the plumbing code.

Reduction: Any heating process, including rendering, cooking, drying, dehydrating, digesting, evaporating and protein concentrating.

Refrigerant: See Section M-801.0.

Refrigerating system: See Section M-801.0.

Regulator, dead weight type: A regulator in which regulating force acting upon the atmospheric side of the diaphragm is derived from a weight or combination of weights.

Regulator, gas-pressure: A device for controlling and maintaining a uniform gas supply pressure.

Regulator, pilot-loaded: The type in which the loading is accomplished by applying gas pressure to the diaphragm of the main regulator through a pilot regulator.

Regulator, spring-type: A regulator in which regulating force acting upon the atmospheric side of the diaphragm is derived from a compressed spring.

Regulator, zero governor: A regulating device which is normally adjusted to deliver gas at atmospheric pressure within its flow rating.

Remote station system: See Section M-1001.0.

Return air system: An assembly of connected ducts, plenums, fittings, registers and grilles through which air from the space or spaces to be heated or cooled is conducted back to the supply unit (see also "Supply air system").

Ringelmann: The standard of smoke density described in the United States Bureau of Mines Information Circular No. 8333, dated May 1967, and the equivalent opacity of all other visible emissions.

Riser: See Section M-1001.0.

Riser, gas: A fuel gas supply pipe which extends vertically one (1) full story or more.

Rupture member: A device that will rupture at a predetermined pressure.

Saturation pressure of a refrigerant: See Section M-801.0.

Seal weld: Any weld used primarily to obtain tightness.

Sealed absorption system: See Section M-801.0.

Sealed combustion chamber appliances: Appliances which are so constructed and installed that all air for combustion is derived from the outside atmosphere, and all flue gases are discharged to the outside atmosphere.

Self-contained system: See Section M-801.0.

Settling or expansion chamber: Any chamber designed to reduce the velocity of the products of combustion to promote the settling of fly ash from the gas stream.

Smolder: To smoke and burn without flames.

Soldered joint: A gas-tight joint obtained by the joining of metal parts with metallic mixtures or alloys which melt at temperatures not exceeding eight hundred (800) degrees F. and above four hundred (400) degrees F.

Spark arrestor: A device to prevent sparks, embers, or other ignited material above a given size from being expelled to the atmosphere.

Sprinkler alarm system: See Section M-1001.0.

Standard, generally accepted: A specification, standard, rule, guide or procedure in the field of construction or related thereto, generally recognized and accepted as authoritative.

Standpipe: See Section M-1001.0.

Stop valve: A shut-off for controlling the flow of liquid or gases.

Sump: A tank or pit which receives the discharge from drains and which must be emptied by mechanical means.

Supply air system: An assembly of connected ducts, plenums, fittings, registers and grilles through which air, heated or cooled, is conducted from the supply unit to the space or spaces to be healed or cooled (see also "Return air system").

Tempered air: Outside air heated before distribution.

Tenant: Shall be construed as a person, firm or corporation possessed with the legal right to occupy premises.

Throttling: See "Modulating".

Ultimate strength: The highest stress level which the component can tolerate without rupture.

Unit heater: A factory-assembled device designed to heat and circulate air. Essential components are a heat transfer element, housing and fan with driving motor. Normally designed for free delivery of recirculated air.

Unit system: A self-contained system which has been assembled and tested prior to its installation and which is installed without connecting any refrigerant-containing parts. A unit system may include factory-assembled companion or block valves.

Unprotected tubing: Tubing which is not protected by enclosure or suitable location so that it is exposed to crushing, abrasions, puncture or similar mechanical damage under installed conditions.

Vacuum breaker: See "Backflow preventor".

Ventilation: The process of supplying air to or removing air from any space. For the purposes of this code, the minimum quantity and quality of outside and exhaust air introduced into or exhausted from the space shall be in compliance with the requirements stipulated herein.

Ventilation system: A mechanical or gravity system installed and operated in such a manner as to secure with normal operation the standard of ventilation required by this code.

Vent: A conduit or passageway, vertical or nearly so, for conveying products of combustion to the outside atmosphere.

Vent connector: The pipe used to connect an approved fuel-fired appliance to a chimney or vent (see also "Flue connection").

Venting system: A continuous open passageway from the flue collar or draft hood of a fuel burning appliance to the outside atmosphere for the purpose of removing products of combustion.

Types of venting systems

1. **Type B and Type B-W:** A gas venting system consisting of vent piping and fittings listed for use with a listed gas appliance.
2. **Type L:** A low temperature venting system consisting of listed vent piping and fittings for use with oil-burning appliances listed for use with Type L vents or with listed gas appliances.

Water heater, domestic type (service): Any heating device with piping connections to the water supply system which is intended to furnish hot water of not more than two hundred (200) degrees F. for purposes other than space heating.

Water spray fixed system: See Section M-1001.0.

Welded joint: A gas-tight joint obtained by the joining of metal parts in the plastic or molten state.

ARTICLE 3

HEATING, COOLING AND VENTILATING

SECTION M-300.0 GENERAL

M-300.1 Scope: The provisions of this article shall govern the construction, installation, alteration, maintenance and repair of all warm air furnaces, stokers, oil-burning, solid fuel-burning, gas-burning, and liquefied petroleum gas-burning and electrical equipment for air heating, ventilating, air conditioning and air pollution control, blower and exhaust appliances and systems and domestic and commercial gas-fired equipment.

M-300.2 Plans: Plans shall be submitted for approval in accordance with the requirements of Article 1 of this code.

M-300.3 Equipment: Warm air heating, ventilating, air conditioning, evaporative cooling, blower and exhaust equipment and their appurtenances shall be of an approved type and shall conform to the requirements of this code and shall be installed in accordance with the manufacturer's installation instructions.

M-300.4 Type of fuel: Appliances shall not be converted from the fuel use intended to a different fuel without conforming to the manufacturer's instructions, and further, shall be approved by the department for the fuel to be used.

M-300.5 Installation: The installation of heating, cooling, blower, exhaust systems and appliances shall conform to the manufacturer's instructions and to the requirements of this code. The contractor or manufacturer shall attach operating instructions of a permanent type to the appliance system, or the instructions shall be placed in a conspicuous place in the mechanical equipment room.

M-300.6 Plenums: The use of uninhabited basements, cellars, crawl spaces, cavity walls, areas above ceilings or attic spaces as supply, make up, exhaust air or return air plenums or ducts is prohibited.

> **Exception:** Air ceiling plenums may be installed as supply or return air plenums in all occupancies except one- and two-family dwellings, provided such air plenums meet the requirements of other applicable articles of this code and of the building code and provided fuel-fired

equipment or exposed combustible materials are not located therein. The use of air ceiling plenums shall be confined to one (1) fire area. The floor or roof assembly above an unlisted air ceiling plenum shall not depend upon the air ceiling for a portion of its fireresistive rating. Insulated cold water, hot water, steam, fire protection and electric lines are allowed in air ceiling plenums. The use of air ceiling plenums in evaporative cooling systems is prohibited. Panning of the joist or stud space for return air is permitted in one- and two-family dwellings only. Crawl spaces not used as storage areas in one- and two-family dwellings may be used for air distribution systems.

M-300.7 Access: All appliances shall be readily accessible for inspection, repair or replacement.

M-300.8 Temporary heating during construction: The use of fuel-fired heaters for temporary heating during construction shall be approved by the department prior to use. All heating equipment, other than approved portable units used during construction, shall be wired and operated so that all controls function in a normal manner.

M-300.9 Guards: Pulleys, belts and similar equipment shall be provided with an approved type guard.

M-300.10 Heat pumps: Heat pumps shall be installed in accordance with the applicable provisions of Article 8 of this code and with nationally recognized practices and standards.

M-300.11 Central warm air heating: In other than one- and two-family dwellings, warm air heating systems shall be of the central warm air type, unless otherwise approved. Fuel-fired unit heaters, suspended furnaces and duct furnaces are prohibited in theaters, assembly halls, places of worship, schools, hospitals, hotels and apartment houses, except where the appliance is enclosed in a one (1) hour fireresistance rated enclosure constructed in conformance with the requirements of the building code.

M-300.12 Motors, fans and blowers: Motors, fans and blower assemblies and their locations shall meet the requirements of the system in which they are installed.

M-300.13 Prohibitions

M-300.13.1 Liquid- and fuel-burning appliances having an integral or directly attached fuel tank shall not be installed.

M-300.13.2 Used furnaces or space heating equipment shall not be installed unless approved by the department prior to installation.

M-300.13.3 Gas logs or open flame-type equipment shall not be installed or located in any building or other structure unless they are installed in accordance with the conditions of approval recommendations of a nationally recognized testing or inspection agency.

M-300.13.4 Heating and cooling equipment, ductwork or piping shall not be permitted in elevator shafts, elevator pits or elevator machine spaces.

M-300.13.5 The use of furnace cement or welding for the repair of heat exchangers is prohibited. Furnace cement may be used for the sealing of joints where required for cast iron furnaces.

M-300.13.6 Gas lines shall not penetrate any supply, return or exhaust duct system.

M-300.13.7 Gas appliances shall not be located within ten (10) feet of the termination of a laundry chute.

M-300.13.8 Furnaces shall not be located in a bedroom, bathroom, storage closet or confined space when the only available access to the furnace is from the bedroom, bathroom or storage closet.

Exceptions

1. Access to attic or underfloor furnaces may be through a closet.
2. Sealed combustion systems.
3. Electric furnaces.

M-300.13.9 The installations and use of floor furnaces is prohibited except in one- and two-family dwellings.

M-300.13.10 The use of unvented fuel-burning space (room) heaters is prohibited; except as provided in Section M-312.0 for unvented infrared space heaters; and except for listed units specifically approved for unvented operation; and except for space (room) heaters installed in fireplaces in dwelling units of one- and two-family dwellings or multiple family dwellings where the open free area of the flue from such fireplace is not less than one (1) square inch per one thousand (1,000) Btus per hour input of the heater. The heater shall be recessed within the fireplace so that the face of the radiants or open (visible) flames are recessed at least six (6) inches from the front of the fireplace opening.

M-300.14 Heat exchangers: Where more than fifty (50) per cent of the air entering the heat exchanger is taken directly from the outside at winter design temperature, the heat exchanger through which such air passes shall be constructed of an approved non-corrosive material unless provisions are made to assure a mixture temperature of at least fifty-five (55) degrees F.

M-300.15 Return air: Air from any boiler room, furnace room, bathroom, kitchen, trash room, janitor storage room, toilet room, garage or storage room containing toxic, flammable, corrosive, radioactive or pathogenic materials shall not be recirculated.

SECTION M-301.0 WARM AIR HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS (ALL OCCUPANCIES EXCEPT ONE- AND TWO-FAMILY DWELLING OCCUPANCIES)

M-301.1 **Scope:** This section applies to air duct systems employing mechanical means for the movement of air used for warm air heating, ventilation, air conditioning systems, exhaust systems and combination heating and air conditioning systems, except that this section shall not apply to systems for the removal of flammable vapors or residues or to systems for conveying dust, stock or refuse by means of air currents.

M-301.2 **Equipment**

M-301.2.1 Mechanical refrigeration, when used in conjunction with air duct systems, shall be installed in conformance with the requirements of this article and Section M-810.0.

M-301.3 **Installation:** Cooling, heating and exhaust systems shall conform to the following Sections M-301.3.1 through M-301.3.4.

M-301.3.1 Heating equipment shall not be located downstream from a cooling unit unless the equipment is accepted for such use by a nationally recognized testing or inspection agency.

M-301.3.2 Heating equipment shall not be located upstream from cooling units, unless such cooling units are designed, equipped and approved for such use.

M-301.3.3 Heating equipment installed parallel with evaporative cooling units shall have an adjustable damper in the circulating air system to direct the air through one of the units and, at the same time, close the passage to stop the flow of air to the other unit. This damper shall be electrically interlocked to insure proper damper position relative to the cycle of operation. Cooled air shall not pass over the heat exchanger of the furnace.

M-301.3.4 Furnaces (including duct furnaces) may be installed downstream from the evaporative coolers or air washers if the heating element is made of corrosion-resistant material, and the heating unit is accepted by a nationally recognized testing or inspection agency for such use. Stainless steel, ceramic-coated steel or aluminum-coated steel in which the bond between the steel and the aluminum is an iron-aluminum alloy are considered to be corrosion-resistant. Air washers operating with chilled water which delivers air below the dew point of the ambient air at the appliance are considered as refrigeration systems. The evaporative cooler or air washer outlet connection and the duct furnace inlet connection shall be made full size, and the connecting duct work shall not exceed fifteen (15) degrees taper on any side. The fresh air intake shall not be closer than ten (10) feet from the duct furnace vent terminal unless such vent outlet is three (3) feet above the air supply inlet.

Exception: Tested and approved package units.

M-301.4 Duct construction: Duct construction shall conform to the following provisions of Sections M-301.4.1 through M-301.4.3.

M-301.4.1 Ducts and plenums may be constructed of approved noncombustible material constructed in accordance with Table M-301.4 or in accordance with accepted engineering practice. Non-metallic ducts shall be constructed and installed in accordance with their approval and the applicable standards listed in Appendix B. Aluminum ducts shall not be used in equipment rooms with fuel-fired equipment, encased in or under concrete slabs on grade, for kitchen or fume exhausts or in systems where air entering the duct is over two hundred fifty (250) degrees F.

M-301.4.2 Ducts or plenums may be of independent construction or may be formed by parts of the building structure as provided for in this code. Ducts and plenums shall be of sheet metal or other approved materials similar in vapor permeability, structural rigidity, air flow friction co-efficient, flexibility and combustibility.

M-301.4.3 Flexible duct connectors of not over fourteen (14) feet of total length shall be permitted in low pressure systems to connect supply air outlets. Flexible duct connectors of not over five (5) feet of total length and in one (1) continuous piece shall be permitted to connect

Table M-301.4
DUCT CONSTRUCTION MINIMUM SHEET METAL GAGES

RECTANGULAR DUCTS

Maximum side inches	Steel min. Galv. Sht. Gage	Aluminum min. B&S Gage
Through 12	26 (0.022 in.)	24 (0.020 in.)
13 through 30	24 (0.028 in.)	22 (0.025 in.)
31 through 54	22 (0.034 in.)	20 (0.032 in.)
55 through 84	20 (0.040 in.)	18 (0.040 in.)
Over 84	18 (0.052 in.)	16 (0.051 in.)

ROUND DUCTS

Diameter Inches	Spiral seam duct	Longitudinal seam duct	Fittings
	Steel min. Galv. Sht. Gage	Steel min. Galv. Sht. Gage	Steel min. Galv. Sht. Gage
Through 12	28 (0.019 in.)	26 (0.022 in.)	26 (0.022 in.)
13 through 18	26 (0.022 in.)	24 (0.028 in.)	24 (0.028 in.)
19 through 28	24 (0.028 in.)	22 (0.034 in.)	22 (0.034 in.)
29 through 36	22 (0.034 in.)	20 (0.040 in.)	20 (0.040 in.)
37 through 52	20 (0.040 in.)	18 (0.052 in.)	18 (0.052 in.)

medium and high pressure terminal boxes. Flexible duct connectors shall be subject to the following provisions:

1. they shall be rated as Class 1 when tested under applicable sections for flexible connectors of the standard for air ducts listed in Appendix B;
2. they shall not penetrate required fireresistance rated assemblies;
3. they shall not pass through floors, walls or ceilings;
4. they shall not be used within six (6) feet of a heating element;
5. the temperature of the air conveyed through such connectors shall not be more than two hundred fifty (250) degrees F;
6. connectors shall conform to the applicable requirements for air ducts;
7. connectors shall be installed in accessible areas only, and
8. connectors shall be rated for the system pressure.

M-301.5 **Vibration isolation connectors:** Vibration isolation connectors inside of buildings shall have a maximum flame spread rating of twenty-five (25). Vibration isolation connectors outside of buildings shall be waterproof. Connectors shall not be over ten (10) inches in length and shall bear the manufacturer's name. Connectors shall not be permitted for range hoods except where such connectors are located exterior to the building.

M-301.5.1 Vibration isolation connectors in duct systems shall be made of flexible material or shall consist of sleeve joints with packing of rope asbestos or other materials having a maximum flame spread rating of twenty-five (25). Connectors exterior to the building shall be waterproof. Vibration isolation connectors shall not be permitted for range hoods, except where such connectors are located exterior to the building. Connectors shall bear the manufacturer's name.

M-301.6 **Lining:** Lining or insulation, when used inside or outside of ducts, shall be of an approved material. Duct coverings and linings shall be installed so as not to interfere with the operation of a fire damper or fire door. Duct coverings and linings shall also be interrupted at the immediate area of operation of heat sources in a duct system involving electric resistance or fuel-burning heaters. Adhesives and sealants shall be of an approved material.

M-301.7 **Prohibited duct openings:** Ducts shall not have openings other than those required for the proper operation and maintenance of the system.

M-301.8 **Joint tape:** Tape used for sealing joints shall be of an approved material with a maximum flame spread rating of twenty-five (25).

M-301.9 **Installation of ducts:** Ducts shall not be installed so as to impair the effectiveness of the fireprotection materials surrounding structural members of the building.

M-301.9.1 Approved fire dampers shall be installed in accordance with Section M-301.11.

M-301.9.2 Supports and hangers for ducts shall consist of strips or rods or other approved hangers of metal attached to framing members at intervals of not more than ten (10) feet.

M-301.9.3 All supply, return and exhaust duct openings shall be capped with suitable material during construction.

M-301.9.4 The use of dual stackheads in bathrooms or toilet rooms is prohibited.

M-301.10 Clearance from warm air ducts, plenums or bonnets: Warm air ducts, plenums or bonnets shall be installed with clearance to combustible material as follows.

M-301.10.1 Where a metal duct pierces a partition or enclosure constructed of combustible material, the space around the duct providing the required clearance may be closed with a thimble or collar, or the wall surface may be extended to the duct with noncombustible materials.

M-301.10.2 In buildings of protected noncombustible construction, clearance shall not be required for bonnets, plenums or ducts. In other type buildings, bonnets or plenums shall have a clearance to combustibles as indicated in Table M-303.

M-301.10.3 Bonnets, plenums or fittings for upflow furnaces shall be extended full size of the furnace to a minimum of eighteen (18) inches above the furnace casing.

M-301.11 Fire dampers: Except when proper fire tests have shown that fire dampers are not necessary to maintain the integrity of the fire-resistance rated assembly, fire dampers complying with the SMACNA Fire Damper Guide, listed in Appendix B, shall be installed in the following locations:

1. Ducts penetrating a fire wall. [When a fire wall is of three (3) hour or greater fire endurance, a fire door is required]
2. Ducts passing through a fire separation wall.
3. Ducts penetrating a fireresistance rated shaft wall. Sub-ducts extending twenty-two (22) inches vertically upward may be used in lieu of fire dampers for exhaust ducts.
4. Ducts penetrating the ceiling of a fireresistance rated floor/roof-ceiling assembly.
5. Ducts penetrating fireresistance rated corridor walls.

M-301.12 Outside air intake: Outside air intake openings for ventilating air shall be located a distance of at least ten (10) feet horizontally from any plumbing vent terminal, unless such intake opening is three (3) feet below the plumbing vent terminal.

M-301.12.1 Outside air intake openings for ventilating air located in exterior walls shall be located at least ten (10) feet (measured in any direction) from any flues, vents, chimneys, gas meters, gas regulators, streets, alleys, parking lots, loading docks or other hazardous or noxious sources, unless such intake opening is three (3) feet below any vent terminal.

M-301.12.2 Exceptions to the above may be approved by the department.

M-301.12.3 Outside air intake and exhaust openings shall be located on the exterior of structures with approved projecting guards, covers or other approved means of preventing the creation of a nuisance and shall not circulate air downward in such a manner as to strike pedestrians.

M-301.12.4 Where outside ventilating air intake and exhaust openings are located in any areaway below grade, the top of the areaway shall be at least twelve (12) inches above the grade level and at least twelve (12) feet from the surface of any street or alley.

M-301.12.5 Outside air intake and exhaust openings shall be protected by approved corrosion-resistant screens, louvers or grates.

M-301.12.6 All outside air intake and exhaust openings shall be protected against weather and water with a weather-resistant hood or louvers.

M-301.12.7 All outside air intakes shall be made and maintained easily accessible for cleaning.

M-301.12.8 Outside air intake and exhaust openings shall be protected against exterior fire exposure in accordance with the building code.

M-301.13 **Controls:** Each air handling system shall be equipped with a high temperature shut-off control and disconnect switch located at a convenient accessible point adjacent to the unit for shutting down of the fan in the event of fire.

M-301.13.1 An approved smoke detection device approved for duct installation shall be installed in each recirculating air or exhaust system having a capacity greater than fifteen thousand (15,000) cubic feet per minute (cfm). In systems between two thousand (2,000) and fifteen thousand (15,000) cfm, a heat detector shall be installed. Detection devices shall be located in the return or exhaust duct system in such a location that it will be sensing room air only. Systems designed with a separate exhaust system capable of exhausting more than fifty (50) per cent of the air supplied shall have a detection device in both the exhaust air and return air systems. Detection devices shall stop the fan(s) automatically. Detectors shall be of the manual reset type. Minimum sensitivity of approved smoke devices shall be set to operate when smoke reduces the intensity of a one (1) foot long beam of white light by four (4) per cent or the equivalent.

M-301.13.2 Where mechanical ventilation is required by the building code, controls shall be provided so that minimum air circulation, outside air supply and exhaust air shall be maintained continuously during periods of occupancy.

M-301.14 Negative pressure from ventilation systems: Ventilation systems shall be designed and installed so that negative pressure from the ventilation system cannot affect the air supply for combustion nor draw products of combustion from appliances, vents or fire places.

SECTION M-302.0 WARM AIR HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS IN ONE- AND TWO-FAMILY DWELLINGS

M-302.1 Scope: This section applies to residence-type central warm air heating and air conditioning systems.

M-302.2 Supply and return ducts and fittings

M-302.2.1 Supply ducts may be constructed of approved noncombustible material constructed in accordance with Table M-301.4 or in accordance with accepted engineering practice. Non-metallic supply ducts shall be constructed and installed in accordance with their approval and the applicable standards listed in Appendix B.

M-302.2.2 Ducts to be installed in floor slabs shall comply with Section M-326.1.2.

M-302.2.3 Joints and seams of supply and return ducts shall be securely fastened and so constructed as to be substantially airtight. Round pipe slip joints shall have a lap of at least one (1) inch, and each joint shall be individually fastened in an approved manner. Duct connections shall not depend entirely on soldered joints or tape. Tape used for sealing joints shall be of an approved material having a maximum flame spread rating of twenty-five (25).

M-302.2.4 Supports and hangers for ducts shall consist of strips or rods of metal attached to joists or other framing members at intervals of not more than ten (10) feet. Nails shall not be driven through fittings or ducts at any point. Lugs or straps shall not be formed by cutting holes in fittings or ducts. The various members shall be connected so that all joints are locked, and the several members shall be attached to each other so as to be for the purposes intended airtight.

M-302.2.5 The panning of joists or studs for return air ducts shall be of galvanized sheet metal at least No. 30 Galvanized Sheet Gage (0.016 inch) or No. 26 B & S Gage aluminum.

M-302.2.6 The interior of combustible ducts shall be lined with metal at points where there is danger from incandescent particles dropping through the register, such as directly under floor registers, adjacent to outdoor intakes and at the bottom of vertical ducts.

M-302.2.7 Vertical stacks for return air shall not be connected to registers on more than one (1) floor.

M-302.2.8 Return air shall not be recirculated from kitchens, bathrooms, toilet rooms, furnace rooms, boiler rooms or garages.

M-302.3 **Furnace settings and controls:** See Table M-303.

M-302.4 **Combustion air and venting:** See Articles 6 and 7.

M-302.5 **Private garage heating:** The discharge opening of warm air ducts extending from any dwelling to its attached garage shall be at least six (6) feet six (6) inches from the floor of the garage. Ontside air shall be supplied to the return air system through a duct having an area at least ten (10) per cent greater than the area of the garage warm air supply. The outside air duct shall not contain a damper. The supply duct shall be provided with a backdraft and fire damper of approved design.

M-302.6 **Negative pressure from ventilation systems:** Ventilation systems shall be constructed and arranged so that negative pressure from the ventilation system cannot affect the air supply for combustion nor draw products of combustion from appliances, vents or fire places.

M-302.7 **Installation**

M-302.7.1 Heating equipment shall not be located downstream from a cooling unit unless the equipment is accepted for such use by a nationally recognized testing or inspection agency.

M-302.7.2 Heating equipment shall not be located upstream from cooling units unless such cooling units are designed, equipped and accepted for such use by a nationally recognized testing or inspection agency.

M-302.7.3 Heating equipment installed in parallel with evaporative cooling units shall have an adjustable damper in the circulating air system to direct the air through one of the units and, at the same time, close the passage to stop the flow of air to the other unit. This damper shall be electrically interlocked to insure proper damper position relative to the cycle of operation. Cooled air shall not pass over the heat exchanger of the furnace.

SECTION M-303.0 FURNACE LOCATIONS AND CLEARANCES (ALL OCCUPANCIES)

M-303.1 **Setting**

M-303.1.1 Furnaces shall be mounted on noncombustible floors unless otherwise provided for in this article. Such noncombustible flooring shall extend at least twelve (12) inches beyond the appliance on three (3) sides and thirty-six (36) inches on the burner control side. Where solid fuel is used, the floor shall extend at least forty-eight (48) inches at the front or sides wherever ashes are removed.

M-303.1.2 Furnaces that are approved specifically for installation on a floor constructed of combustible material may be mounted in accordance with the conditions of such approval.

M-303.1.3 All heating furnaces shall be approved and bear the label of a nationally recognized testing or inspection agency.

M-303.1.4 Downflow furnaces shall be installed on a noncombustible floor or on a base accepted by a nationally recognized testing or inspection agency. Such base shall be furnished by the manufacturer, and such installation shall be made consistent with such acceptance.

M-303.1.5 Bonnets, plenums or fittings for upflow furnaces shall be extended full size of the furnace to a minimum of eighteen (18) inches above the furnace casing.

M-303.2 Clearances: All mechanical appliance clearances to combustible material as specified by this article shall be in conformance with the requirements of Table M-303. Heating equipment shall not be installed in confined spaces, such as alcoves or closets, unless equipment has been approved specifically for such installation and is installed in accordance with the conditions of such approval.

> **Exceptions:** Heating equipment approved specifically for installation with clearance less than specified in Table M-303 may be installed in accordance with the condition of such approval.

SECTION M-304.0 CLEARANCE AND CONTROLS: See Table M-303

SECTION M-305.0 HEATING EQUIPMENT LOCATED IN ATTIC SPACES

M-305.1 Installation: Heating equipment shall not be installed in attic or attic spaces unless such equipment is of an approved type for installation in such space. Liquefied petroleum gas-fired appliances shall not be installed in attics or furred spaces, unless such spaces are provided with an approved means for removal of unburned gas.

M-305.2 Access

M-305.2.1 The space, in which any attic furnace is installed shall be accessible by an opening and passageway at least the size required to install or remove the largest major component of the unit without disassembling, and such opening shall not be less than thirty-six (36) by thirty-six (36) inches. Access openings to attics shall be so located that a clearance of four (4) feet exists between the top of the ceiling joist and the bottom of the rafters at the point of entrance.

M-305.2.2 The entrance to the access passageway shall be located not more than twenty (20) feet from the furnace.

Table M-303

CLEARANCES AND CONTROLS

(For explanatory notes a through m, see page 42)

Type of furnace	Standard or reduced clearance furnace	Type of fuel	High limit required	Max. outlet air temp.	High limit integral	Minimum clearance requirements (inches to combustibles) for approved warm air heating equipment					
						Above and sides of bonnet or plenum	Above and sides of bonnet or plenum reduced	Jacket sides and rear	Service sides	Project. draft hood or connector pipe (m)	Vent (m)
Upflow forced air	Standard	Liquid	Yes	250 F	Yes*	2	(a)	6	24	18	18
	Standard	Gas	Yes	250 F	Yes*	2	(a)	6	24(e)	6	6
	Reduced	Liquid	Yes	200 F	Yes	1	(c)	As approved	24	18	18
	Reduced	Gas	Yes	200 F	Yes	1	(c)	As approved	24(e)	6	6
Downflow forced air	Standard on non-combustible floors	Liquid	Yes	250 F	Yes	2(d)	2(d)	6	24	18	18
		Gas	Yes	250 F	Yes	2(d)	2(d)	6	24(e)	6	6
	Standard on combustible floors	Liquid	Yes	200 F	Yes	2(d)	2(d)	6	24	18	18
		Gas	Yes	200 F	Yes	2(d)	2(d)	6	24(e)	6	6
	Reduced	Liquid	Yes	200 F	Yes	2(d)	2(d)	As approved	24	18	18
	Reduced	Gas	Yes	200 F	Yes	2(d)	2(d)	As approved	24(e)	6	6
Horizontal forced air (attic units)	Standard	Liquid	Yes	200 F	Yes	2	(b)	6	24	18	18
	Standard	Gas	Yes	200 F	Yes	2	(b)	6	24(e)	6	6
	Standard	Gas	Yes	200 F	Yes	2	(b)	6(f)	24	6	6

Table M-303 (cont'd)
CLEARANCES AND CONTROLS

Type of furnace	Standard or reduced clearance furnace	Type of fuel	High limit required	Max. outlet air temp.	High limit integral	Minimum clearance requirements (inches to combustibles) for approved warm air heating equipment					
						Above and sides of bonnet or plenum	Above and sides of bonnet or plenum reduced	Jacket sides and rear	Service sides	Project. draft hood or connector pipe (m)	Vent (m)
Gravity	Standard	Liquid	Yes	250 F	Yes*	2	(a)	6	24	18	18
	Standard	Gas	Yes	250 F	Yes*	2	(a)	6	24(e)	6	6
	Reduced	Liquid	Yes	200 F	Yes	1	(c)	As approved	24	18	18
	Reduced	Gas	Yes	200 F	Yes	1	(c)	As approved	24(e)	6	6
Room (space) heaters	—	Liquid	—	—	—	—	—	18	24	18	18
	—	Gas	—	—	—	—	—	6	24(e)	6	6
Unit heater suspended	Standard	Liquid	Yes	250 F(g)	Yes	—	—	18	24	18	18
	Standard	Gas	Yes	250 F	Yes	—	—	(h)	24	(i)	(j)
	Reduced	Liquid	Yes	250 F(g)	Yes	—	—	As approved	24	18	18
	Reduced	Gas	Yes	250 F	Yes	—	—	(k)	24	6" above elbow	(j)
Unit heater floor mounted	Standard	Liquid	Yes	250 F(g)	Yes	—	—	18	24	18	18
	Standard	Gas	Yes	250 F	Yes	—	—	(l)	24	6	6
	Reduced	Liquid	Yes	250 F(g)	Yes	—	—	As approved	24	18	18
	Reduced	Gas	Yes	250 F	Yes	—	—	As approved	24	6	6
Duct heaters	Standard	Liquid	Yes	250 F(g)	Yes*	—	—	18	24	18	18
	Standard	Gas	Yes	250 F	Yes*	—	—	6	24	6	6
	Reduced	Liquid	Yes	250 F(g)	Yes*	—	—	18	24	18	18
	Reduced	Gas	Yes	250 F	Yes*	—	—	As approved	24	6	6

Notes to Table M-303

*Furnace may have integral or separate limit control. See note (a) for requirements.

Note a. Distance may be reduced to 1″ if the limit control used has been tested by an approved agency and cannot be set higher than 250° F., installed not more than 10″ above the top surface of the heat exchanger in a supply plenum that extends at least 12″ above the top surface of the near exchanger. The distance must be increased to 6″ if the above specified distances cannot be adhered to.

Note b. A minimum of 6″ from combustible material must be maintained for a distance of at least 12″ from the downstream side of the heat exchanger.

Note c. This clearance may be reduced to zero if ⅝″ gypsum board is provided over the plenum and extending 6″ beyond the plenum on all sides.

Note d. Sides and bottom of bonnet or plenum.

Note e. Where a door is provided on the service side of the furnace, the clearance on this side may be reduced to 12″.

Note f. Not less than 1″ ventilated clearance from the bottom of the unit to the asbestos millboard below.

Note g. If connected to ductwork.

Note h. 18″ at sides, 12″ at bottom, 6″ above top when unit has internal draft hood.

Note i. 1″ above top of sloping side of a vertical draft hood.

Note j. 6″ from ell on diverter.

Note k. 6″ from relief opening of draft hood.

Note l. Back and one side only not less than 6″.

Note m. If listed Type B or Type L venting system piping is used, the clearance may be in accordance with the venting system listing.

M-305.2.3 Access to the attic opening shall be provided by a ladder or stairway permanently fastened to the building. Other access methods shall require approval prior to installation.

M-305.2.4 There shall be an unobstructed catwalk leading from the access opening to the service side of the furnace. Such catwalk shall have a nominal width of twenty-four (24) inches and shall be securely fastened to the ceiling joist.

M-305.3 Furnace setting

M-305.3.1 All attic furnaces shall be set on an unobstructed, approved platform which shall extend at least twelve (12) inches on all sides of the furnace, except that on the control side or other sides where access is necessary for servicing, the platform shall extend a distance of thirty-two (32) inches from the furnace.

M-305.3.2 The platform on which the unit rests shall be covered with at least one-quarter (¼) inch asbestos millboard or its equivalent. Such board shall be placed under the furnace and shall extend at least twelve (12) inches beyond all sides and thirty-two (32) inches on the control or service side.

M-305.3.3 Attic furnace platforms shall not bear on or contact the ceiling joists unless such platforms are protected as provided in Section M-305.3.2, and the joists are designed for such loads. If supported by the roof joists, the design live and dead load shall not be exceeded. The furnace shall be provided with at least one (1) inch ventilated clearance from the bottom of the unit to the asbestos millboard. For clearance to combustible materials, see Table M-303.

M-305.3.4 **Filters:** See Section M-324.0.

M-305.3.5 **Ducts:** See Section M-301.4.

M-305.3.6 **Venting and combustion air:** See Articles 6 and 7.

M-305.3.7 **Electrical:** Attic furnace installations shall comply with Section M-627.0.

SECTION M-306.0 APPLIANCES ON ROOFS

M-306.1 **General:** In addition to the other provisions of this article, roof-mounted appliances shall conform to the following Sections M-306.1.1 through M-306.1.3.

M-306.1.1 Appliances shall be approved for outdoor installation and shall be designed to withstand atmospheric and climatic conditions in the areas in which they are to be installed.

M-306.1.2 Roofs on which appliances are to be installed shall be capable of supporting the additional load due to the appliance weight and dynamic action.

M-306.1.3 All access locks, screws and bolts shall be of corrosion-resistant material.

M-306.2 **Installation**

M-306.2.1 Appliances shall be installed in accordance with their approval and in accordance with the manufacturer's installation instructions.

M-306.2.2 Appliances shall be installed on a well-drained surface. At least six (6) feet clearance shall be maintained between the appliance and the edge of a roof or similar hazard. Otherwise rigidly fixed rails or guards at least three (3) feet in height shall be provided on the exposed side, except that parapets at least three (3) feet in height may be utilized in lieu of rails or guards.

M-306.2.3 Each appliance shall have an accessible weatherproof disconnect switch and a 110-120 volt AV grounding-type convenience outlet on the roof adjacent to the appliance. The convenience outlet shall be on the line side of the disconnect switch.

M-306.2.4 See the building code for requirements on curbs and flashings.

M-306.3 **Access to appliances**

M-306.3.1 Adequate access to appliances located on roofs or other elevated locations shall be provided.

M-306.3.2 Permanent outside access may be used on single story buildings not over twenty (20) feet in height. All other means of access shall be a permanent or fold-away inside stairway or ladder with railings, terminating in an enclosure, scuttle or trap door. Such scuttles or trap doors shall be at least thirty (30) inches in the smallest dimension and shall open easily and safely under all conditions, especially snow, and shall be constructed so as to permit access from the roof side, unless deliberately locked on the inside. At least six (6) feet clearance shall be available between the access opening and the edge of a roof or similar hazard. Otherwise rigidly fixed rails or guards at least three (3) feet in height shall be provided on the exposed side, except that parapets at least three (3) feet in height may be utilized in lieu of guards or rails.

M-306.3.3 Proper permanent lighting shall be provided at the roof access. The switch for such lighting shall be located inside the building near the access means leading to the roof.

M-306.3.4 Every appliance located on a roof of a building shall be installed on a substantial level platform. Whenever the roof has a slope greater than three (3) inches measured vertically to twelve (12) inches measured horizontally, a level working platform not less than thirty (30) inches in depth shall be provided on each downslope side of the appliance. All sides of any working platform shall be protected by a substantial railing thirty-six (36) inches in height with vertical rails not more than twenty-one (21) inches apart, except that parapets at least thirty-six (36) inches in height may be utilized in lieu of rails or guards. Scuttles located on other than the roof incline side of the equipment unit shall have their lids or trap doors hinged on the low side of the scuttle. Such lids or trap doors shall be equipped with means to ensure an opening radius of not less than ninety (90) degrees nor more than one hundred (100) degrees from the closed position. Scuttle lids or trap doors and hardware, when opened, shall be capable of withstanding a three hundred (300) pound lateral load from the roof incline side.

M-306.3.5 Level catwalks not less than twenty-four (24) inches wide shall be provided from the roof access to every required working platform at the appliance. Catwalks with slope greater than twelve (12) inches to three (3) inches shall be provided with substantial cleats spaced not more than sixteen (16) inches apart. The downslope side of catwalks on pitched roofs shall be provided with minimum thirty-six (36) inch high hand rail.

SECTION M-307.0 HEATING EQUIPMENT LOCATED IN CRAWL SPACES

M-307.1 **Crawl Space:** A minimum height of thirty (30) inches shall be maintained throughout the entire crawl space area from the ground level to the bottom of the floor joist.

M-307.2 Clearance: For clearance to combustible materials see Table M-303. If other than a horizontal type is used, bonnets, plenums and fittings for upflow furnaces shall be extended full size of the furnace outlet to a minimum of eighteen (18) inches above the furnace casing.

M-307.3 Installation: Heating equipment on grade shall be placed on a concrete slab of at least four (4) inches in thickness, and such slabs shall be above the level of the surrounding ground in the crawl space. The slab shall be constructed to extend at least six (6) inches on all sides of the furnace.

> **Exception:** Where clearances cannot be maintained between the top of the heating equipment and combustible portions of the structure, equipment may be installed in a depression or excavation. A concrete floor and retaining wall shall be constructed in the depression, and the wall shall extend to a point four (4) inches above the surrounding grade. The floor of the depression shall extend six (6) inches beyond all sides of the equipment and twenty-four (24) inches on the service side. Depressions greater than thirty-six (36) inches below grade shall be provided with a stairway and handrails, and the burner control clearance shall be increased to a minimum forty-eight (48) inches.

M-307.4 Illumination: See Section M-627.0.

M-307.5 Access

M-307.5.1 Means of access to crawl space areas shall not be through the floor above unless approved by the department .

M-307.5.2 A vertical access opening shall be provided, and the furnace shall be located not more than twenty (20) feet therefrom.

M-307.5.3 In addition to the other requirements in the building code, the space in the crawl space where heating equipment is to be installed shall be accessible by an opening and passageway at least as large as that required to install or remove the heating equipment without disassembling such equipment. Liquefied petroleum gas-fired heating appliances shall not be installed in any underfloor space unless such space is provided with an approved means for removal of unburned gas.

SECTION M-308.0 FLOOR FURNACES (ONE- AND TWO-FAMILY DWELLINGS)

M-308.1 Clearance: Flat floor furnaces shall be installed not less than six (6) inches from walls. Wall register floor furnaces shall be installed not less than six (6) inches from inside room corners.

> **Exception:** Replacement floor furnaces of the same or lesser input rating may be installed in the original location as approved by the department.

M-308.2 Installation

M-308.2.1 Floor furnaces shall not be located where a door can swing within twelve (12) inches of the warm air outlet.

M-308.2.2 Floor furnace warm air outlets shall not be installed less than sixty (60) inches below overhead projections.

M-308.2.3 A clear floor space of twenty-four (24) inches shall be provided along two (2) adjoining sides of flat floor furnaces.

M-308.2.4 The floor furnace burner assembly shall not project into an occupied underfloor area.

M-308.3 **Access:** An opening and passageway not less than twenty-four (24) inches by eighteen (18) inches shall be provided to every floor furnace. The passageway shall be not more than twenty (20) feet in length from the access opening or from an underfloor area thirty (30) inches or more in height.

M-308.4 **Setting**

M-308.4.1 Floor furnaces shall be supported independently of the grille and shall have not less than six (6) inches clearance from grade. Floor furnaces shall not be installed on concrete slabs on grade.

> **Exception:** Sealed furnaces may have a grade clearance of two (2) inches.

M-308.4.2 Furnace excavations shall extend not less than thirty (30) inches beyond the control side and twelve (12) inches beyond the sides and back of the furnace. The excavation shall slope outward from the bottom to the natural grade at an angle not greater than forty-five (45) degrees from the horizontal.

SECTION M-309.0 HEATING AND VENTILATING EQUIPMENT IN HAZARDOUS OCCUPANCIES

M-309.1 **General:** Heating and ventilating equipment in occupancies involving fire hazards from flammable vapors, dust, combustible fibers or other highly combustible substances shall be installed and protected against fire and explosion hazards in accordance with nationally recognized safety practice standards and as approved by the department prior to installation.

SECTION M-310.0 SERVICE STATIONS

M-310.1 **Definition:** See the building code of this jurisdiction.

M-310.2 **Location of heating equipment:** Heating equipment to be installed in service stations shall be located at least five (5) feet six (6) inches from the floor to the bottom of the unit and at least eight (8) feet in the lubritory area. Heating equipment shall not be located below grade.

M-310.3 Clearance: Suspended horizontal furnaces shall be installed with clearances as shown in Table M-303.

M-310.4 Ducts: Return air and supply air shall be provided to the furnace through approved ducts. Duct construction shall conform to the requirements of Table M-301.4 and/or the standards listed in Appendix B.

M-310.5 Additional requirements: In addition to the requirements of this section, furnaces installed shall meet the requirements of Article 6.

SECTION M-311.0 SPACE (ROOM) HEATERS

M-311.1 General: Heaters shall not be installed as a central heating system unless as otherwise approved by the department.

M-311.1.1 Fuel-burning space heaters shall be equipped with a flame safeguard.

M-311.1.2 Space heaters shall be installed so as not to cause a fire hazard to walls, floors, curtains, furniture, open doors, or to the free movement of persons within the room. See Table M-303.

M-311.1.3 The use of fuel-burning unvented space heaters is prohibited, except as provided for in Section M-300.13.10.

M-311.2 Through-the-wall heaters

M-311.2.1 Through-the-wall heaters shall not be installed as central heating except as otherwise approved by the department.

M-311.2.2 Combustion air intakes and/or vents shall be located on the exterior of the building, and such openings shall be at least twelve (12) inches above the exterior finished grade. When such heaters are located in garages or accessory use buildings where motor-driven vehicles or devices utilizing volatile liquids are housed or stored, combustion air openings and vents shall be located at least eighteen (18) inches from the exterior finished grade, and interior pilot light access opening shall be located at least eighteen (18) inches from the finished floor. Where combustion air intake openings are located immediately adjacent to a driveway, the exterior eighteen (18) inch height requirements shall apply. The equipment shall be protected from any type of mechanical injury from vehicular traffic. Vents from such heaters shall not be located within twelve (12) inches of any window, door or opening into a building.

M-311.2.3 Clearances: Through-the-wall heaters shall not be installed within twelve (12) inches from any projecting combustible material which extends vertically or horizontally from the wall surface. Such heaters shall not be located within twelve (12) inches of the corner of the building or any other projection from the wall surface on which they are installed.

Exception: Through-the-wall heaters may be installed with lesser clearances when accepted by a nationally recognized testing or inspection agency.

M-311.2.4 Prohibited installations: Through-the-wall heaters shall not extend into any public walkway or public way or private walkway in such a manner that would constitute a hazard to the public.

M-311.3 Recessed (wall) heaters

M-311.3.1 Recessed heaters shall not be installed as central heating except as provided for in Section M-300.11.

M-311.3.2 Recessed heaters shall be an approved type and shall be installed in accordance with the requirements of their listing, the manufacturer's instructions and the requirements of this code.

M-311.3.3 Panels, grilles or access doors shall be provided to allow normal servicing operations to recessed heaters.

M-311.3.4 Recessed heaters installed in rooms normally kept closed shall be equipped with a flame safeguard and such rooms shall be provided with adequate combustion air.

SECTION M-312.0 INFRARED SPACE HEATERS (GAS-FIRED AND OIL-FIRED)

M-312.1 General: Approved vented infrared fuel-fired heating units may be utilized when installed in accordance with their listing. Unvented infrared fuel-fired heating units for space heating in industrial occupancies shall be considered vented when the units do not exceed input ratings of fifty thousand (50,000) Btus per hour per unit and have been approved for use without directly connected vents and installed in accordance with the following provisions of this section.

M-312.2 Ordinary occupancy

M-312.2.1 For full building heating by infrared space heaters, the units shall be mounted with strict adherence to clearances to combustibles as determined by a nationally recognized testing or inspection agency, and as indicated in the listing and in accordance with the manufacturer's recommendations. Units for spot heating applications may be at a lower mounting height than that for full building heating.

M-312.2.2 Natural or mechanical ventilation shall be provided for the space to be heated. Provision must be made for both outside air supply and exhaust. Natural ventilation shall consist of sufficient outlet area adequately distributed above the units and having a capacity to reduce the CO_2 produced by the units to five thousand (5,000) parts per million (ppm) of air and to reduce the CO produced to fifty (50) ppm of air (3.8 and 4.55 cfm/1,000 Btu/hr for natural and propane respectively). Capacity shall be determined by the following formula:

$$V = 9.4 A \sqrt{H (t_i - t_o)} \qquad A = \frac{V}{9.4 \sqrt{H (t_i - t_o)}}$$

Where

V = Volume of air exhausted in cubic feet per minute (cfm)
A = Free area of outlets in square feet
H = Height from inlets to outlets in feet
t_i = Average temperature of indoor air in height H in degrees Fahrenheit
t_o = Outdoor air temperature in degrees Fahrenheit

Inlet air area shall be fixed and equal in amount to the outlet area as determined in A above. Infiltration area can be included in the inlet area. If by virtue of other mechanical exhaust equipment and provided more than two (2) air changes per hour produces a negative pressure in the building space, positive mechanical supply of air in equal amount of excess over two (2) air changes per hour must be provided. This supply air shall be tempered with inside air or be pre-heated. Mechanical ventilation systems, where used, shall consist of fans or blowers providing a positive pressure in the space. Fixed exhaust openings shall be provided at the high point of the space. Exhaust area shall be equal to two (2) square feet per one thousand (1,000) cfm introduced. Air provided must be in an amount sufficient to reduce CO and CO_2 as indicated in the above and must be tempered with inside air to be preheated. Mechanical ventilation shall be interlocked with the heaters so that the heaters cannot operate unless the mechanical ventilation is operating.

M-312.3 Semi-hazardous occupancy (garages and aircraft hangars)

M-312.3.1 Units shall be listed for use in the areas by a nationally recognized testing or inspection agency and shall be installed and located in accordance with NFiPA 88 and 409 listed in Appendix B. Sections M-312.2.1 and M-312.2.2 shall also apply.

M-312.3.2 Ventilation shall be of the mechanical type and shall comply with Section M-317.0 of this article. In addition, the ventilation system shall be so designed as to maintain a zero or positive pressure in the space at all times.

M-312.3.3 An auxiliary positive air supply and fixed exhaust openings in the high point of the space must be provided in order to reduce the CO_2 and CO produced by the heaters to five thousand (5,000) ppm and one hundred (100) ppm of air respectively, as described above. This auxiliary system is to be so interlocked with the main ventilation system that it will operate when the main ventilation system is not operating. Under this condition, the auxiliary system need operate only when heaters are on.

SECTION M-313.0 SUSPENDED FUEL-FIRED UNIT HEATERS

M-313.1 **Location:** In addition to other approved locations, approved unit heaters may be installed in garages, enclosed loading docks and similar occupancies. When such heaters are to be installed in public repair or storage garages and suspended from the ceiling or roof, they shall be at least eight (8) feet measured from the floor to the bottom of the unit. In spaces where vehicular equipment in excess of six (6) feet in height is present, a minimum of two (2) feet clearance shall be provided between the bottom of the unit heaters and the top of such equipment.

M-313.1.1 Unit heaters to be installed in private garages and suspended from the ceiling or roof shall be installed with a clearance of at least five (5) feet six (6) inches measured from the floor to the bottom of the unit.

M-313.1.2 The location of such heaters to be installed in hazardous occupancies and airplane hangers shall be approved prior to installation.

M-313.2 **Clearance:** For clearance to combustible materials, see Table M-303. Heaters approved for lesser clearance may be installed accordingly.

M-313.3 **Venting:** See Article 7.

F-313.4 **Supports:** Suspended type unit heaters shall be safely and adequately supported. Hanger brackets and other such supports shall be of noncombustible material.

M-313.5 **Combustion air:** See Article 6.

M-313.6 **High static duct heaters:** When such heaters are used in conjunction with a duct system, they shall be installed in accordance with the duct work and clearance requirements of this article.

M-313.7 **Low-static unit heaters**

M-313.7.1 Ducts shall not be used in conjunction with low-static unit heaters.

M-313.7.2 **Central warm air heating:** See Section M-300.11.

SECTION M-314.0 GRAVITY WARM AIR SYSTEMS

M-314.1 **Location:** Gravity furnaces shall be located so that the length of the warm air pipes shall be equalized as nearly as practicable, with due preference to rooms which have unusual heating requirements.

M-314.2 **Separation**

M-314.2.1 Where warm air and return air pipes on gravity systems are six (6) inches or less apart, at least one-half (½) inch of approved insulation shall be installed on the return air pipe.

M-314.2.2 Where the distance between return pipes and vent pipes is twelve (12) inches or less in solid or liquid fuel furnaces, or six (6) inches or less in gas furnaces, such return pipes shall be insulated with at least one-half (½) inch insulating material or with reflective metal set one (1) inch out from the pipe.

M-314.3 Material: Warm air pipes shall be constructed entirely of noncombustible material equivalent to the structural strength and durability required in Table M-301.4.

M-314.4 Construction: Warm air pipes shall be constructed in the following manner described in Sections M-314.4.2 through M-314.4.8.

M-314.4.1 Side seams shall be locked seams.

M-314.4.2 Joints shall be either seamed or lapped at least one and one-half (1½) inches.

M-314.4.3 Pipes and fittings shall be properly secured to ceiling or joists with metal lugs or straps.

M-314.4.4 Gravity warm air supply runs in basements shall have a vertical rise of one (1) inch for each horizontal run of one (1) foot. On extended plenums, or where the total rise is taken at the furnace, the rise shall be at least one and one-half (1½) inches per linear foot of run.

M-314.4.5 Warm air pipes shall afford a clearance of at least one (1) inch from any combustibles.

M-314.4.6 Warm air pipes from solid and liquefied fuel gravity furnaces shall be at least six (6) inches from combustible material for a distance of six (6) feet from the furnace plenum.

M-314.4.7 Adhesive coverings for pipes if used, shall be of material approved for such use.

M-314.4.8 The return air supply to the furnace may be taken from within the building or may be taken partially from outside and partially from within. If a proportioning damper is used on such split air supply, it shall be so arranged that for all possible positions of the damper, the total open cross-sectional area shall be at least the total cross-sectional area of all warm air outlets. All joints in the pipe system shall be made dust-tight.

M-314.5 Dampers: Warm air pipes in basements shall be provided with locking-type dampers which shall be supported on both sides of the pipe and which shall be located not more than two (2) feet from the furnace casing.

M-314.6 Thimbles: Warm air pipes which pass through masonry walls shall be equipped with a metal ventilated thimble, the diameter of which shall be at least one (1) inch greater than that of the pipe. The pipe shall be supported in such a manner that the air space or insulation is equal on all sides.

M-314.7 Boots or shoes: Where the return air pipe is connected to the furnace casing at the base, the opening shall not extend higher than fourteen (14) inches from the bottom of the furnace.

M-314.8 Vertical pipes or stacks: Vertical pipes or stacks for return air shall not be connected to registers on more than one (1) floor.

M-314.9 Fire dampers: Approved fire dampers shall be used where any duct passes through a required fireresistance rated wall. See Section M-301.11.

SECTION M-315.0 CONVERSION BURNERS IN WARM AIR FURNACES

M-315.1 General: Prior to the installation of a conversion burner, the contractor shall ascertain whether the entire heating system is in safe condition for the installation of such burner and so certify in writing to the department prior to conversion.

M-315.1.1 Furnaces in which conversion burners are installed shall be equipped with approved high limit controls as required in Table M-303.

M-315.2 Combustion air and venting: See Articles 6 and 7.

M-315.3 Additional requirements: Conversion burners shall comply with the requirements of Article 6.

M-315.4 Gravity furnaces shall not be converted for use as forced air furnaces.

SECTION M-316.0 DIRECT GAS-FIRED MAKEUP AIR HEATERS

M-316.1 Installation: Direct gas-fired makeup air heaters may be installed only in occupancies of use groups H (high hazard), S (storage) or F (factory and industrial) unless otherwise approved by the department.

M-316.2 Negative pressure: Direct gas-fired makeup air heaters may be used to correct a negative pressure condition within a building where exhaust fans are in operation.

M-316.3 Discharge: The total discharge of such equipment shall not exceed one hundred ten (110) per cent of the capacity of the exhaust system in conjunction with which it is used.

M-316.4 Air: All air handled by such equipment, including combustion air, shall be brought in from outside.

M-316.5 Gas ratio: The ratio of gas input by volume to the total volume of mixture discharged by such equipment shall not exceed two-tenths of one per cent (0.2%).

M-316.6 Controls: Direct gas-fired air heaters shall be electrically tied in with its corresponding exhaust system so that it can be in operation only when the exhaust system is in operation. In lieu of an electrical tie-in, equivalent reliable means to provide this requirement, within the limit specified in Section M-312.2.2 may be substituted if acceptable to the department.

M-316.6.1 Such equipment shall be provided with air-flow sensing devices so designed and installed as to shut off the gas burner upon failure of either combustion air or main air supply (controls actuated by failure of the power supply to the blower motor do not meet this requirement).

M-316.6.2 Such equipment shall be provided with combustion safeguards, including quick-acting, manual reset safety shut-off valves, and with combustion air-gas interlocks where applicable, as required by this code.

M-316.6.3 Such equipment shall be provided with both a thermostatic device (for normal operation of the gas burner component) and a high temperature limit control. The latter shall be set at a temperature not to exceed one hundred twenty (120) degrees F.

M-316.7 **Clearance:** Such equipment shall be so installed as to not raise the temperature of surrounding combustible material to higher than one hundred sixty (160) degrees F.

SECTION M-317.0 VENTILATION

M-317.1 **General:** In addition to the provisions of other portions of this code, the following ventilation requirements described in Sections M-317.1.1 through M-317.1.18 shall apply.

M-317.1.1 Ventilation is the providing and maintaining in rooms or spaces, by mechanical or natural means, the conditioning of air which will protect the health, safety and welfare of the occupants thereof.

M-317.1.2 The installation of all ventilating systems shall be performed in conformity with the provisions of this article, the building code and the standards listed in Appendix B.

M-317.1.3 The ventilating requirements as herein stated shall apply to every room designed, erected, altered or converted for the purpose enumerated.

M-317.1.4 Openings shall be provided to remove excessive heat or gases which may accumulate in a room or area.

M-317.1.5 The ventilating requirements shall be based on the purpose for which the rooms are used, regardless of the classifications of use, occupancy or construction in which it is located.

M-317.1.6 The method of producing ventilation and the minimum quantities of air to be supplied and exhausted by mechanical ventilating systems shall be as stated in this article (see Table M-317).

M-317.1.7 Ventilating systems shall be provided, maintained and operated to accomplish required ventilation service for all occupied areas within the scope of this article.

M-317.1.8 Exhaust systems shall be provided, maintained and operated for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders and any other equipment and processes in such areas produce or throw off dust or particles sufficiently light to float in the air or which emit heat odors, fumes, spray, gas or smoke, in such quantities as to be irritating or injurious to the health or safety, and shall mechanically discharge such exhaust to the outdoor atmosphere. The total outdoor air supplied shall be equal in volume to that removed and shall be conditioned to a temperature equal to the normal temperature of the space from which the air was removed.

M-317.1.9 All equipment and system service rooms which house sources of odors, fumes, noxious gases, smoke, dust, spray or other contamination shall be such as to prevent spreading of any such contamination to any other occupied parts of the building.

M-317.1.10 All ventilating and exhaust systems shall be operated to satisfy the requirements of this article during periods the building is occupied, unless otherwise exempted by this article.

M-317.1.11 Air exhausted from bath, toilet, urinal, lavatory, locker, coat room, kitchen, boiler room or rooms of similar use shall not be recirculated at any time.

M-317.1.12 If a mechanical ventilating supply system only is installed for a room, or if a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical ventilating exahust system for a room, adequate means shall be provided for the natural exit of the excess air supplied. If a mechanical ventilating exhaust system only is installed for a room or if a greater quantity of air is removed by a mechanical ventilating exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate means shall be provided for the natural supply of the deficiency in the air supplied.

M-317.1.13 The air removed by every mechanical ventilating exhaust system shall be discharged out-of-doors at a point where it will not cause a nuisance, and from which it cannot again be readily drawn in by a ventilating system, except that air which is to be used for recirculation may be discharged to a supply system.

M-317.1.14 Mechanical exhaust from bath, toilet, urinal, locker, service sink, closets and similar rooms shall be an independent system.

M-317.1.15 The materials used in every mechanical ventilating air supply and air exhaust system shall be of sheet metal or other approved materials. Materials shall be of non-absorbent and moisture- and corrosion-resisting character.

The design and construction of all equipment and the weight and bracing of all duct work shall be such that it will operate under normal conditions without excessive vibration. Ducts shall be substantially airtight. Linings, if used, shall be securely anchored.

M-317.1.16 Fire dampers shall be installed as required in Section M-301.11.

M-317.1.17 If an installation is a mechanical ventilating exhaust system without a mechanical ventilating supply system, or if it is a mechanical ventilating supply system, either with or without a mechanical ventilating exhaust system, the equipment shall be sufficient to warm makeup air from the seasonal low temperature (of the area in which the building is located) to a temperature of sixty (60) degrees F.

M-317.1.18 In addition to the requirements of this article, the department may require other ventilation air where a special hazard exists or may exist.

M-317.2 Use classification: The various uses to which the provisions of this article apply shall be classified as follows.

Use Class I.	Require ventilation on an occupancy basis. See Table M-317.
Use Class II.	Require ventilation on an occupancy basis unless otherwise exempted. See Table M-317.
Use Class III.	Require exhaust. See Table M-317.
Use Class IV.	Require ventilation on the basis of floor area. See Table M-317.

M-317.3 General requirements, Class I and II: These requirements shall apply to all occupancies listed under I and II in Section M-317.2 and Table M-317, unless otherwise exempted in this code.

M-317.3.1 The total air circulated for all occupancies in this classification shall be at least six (6) air changes per hour, unless otherwise provided for by this article. The air delivery capacity of all equipment supplying air for heating, ventilation and air conditioning purposes shall be sized for this geographic location.

M-317.3.2 The outside air supply during occupancy shall be at least seven and one-half (7½) cubic feet per minute per occupant, and an equal amount shall be exhausted, unless otherwise exempted by this article.

M-317.3.3 All air outlets and returns shall be so located, arranged or equipped as to provide a uniform distribution of air without excess velocity.

M-317.3.4 Equipment with automatic controls shall be provided to maintain temperature and controlled ventilation to satisfy the following conditions during periods the area is occupied, and shall provide a continuous air movement of at least the minimum required by this article, and shall provide a continuous supply of tempered outside air, as determined by the number of occupants, of at least seven and one-half (7½) cubic feet of air per minute per person.

M-317.4 **Places of assembly:** This classification shall include all occupancies such as arenas, armories, assembly halls, banquet halls, billiard rooms, bowling alleys, cafeterias, club rooms, dance halls, dining rooms, gymnasiums, lecture halls, lodge halls, playrooms, restaurants, school auditoriums, skating rinks and theaters. Those occupancies which accommodate less than fifty (50) persons shall conform to the requirements of Section M-317.12.

M-317.4.1 The air movement, outside air supply and air distribution for all occupancies under this classification shall conform to the requirements of Section M-317.3. For theaters, assembly halls, gymnasiums and similar occupancies having a ceiling height of fifteen (15) feet or more, the total air movement shall be based on six (6) air changes per hour. For theaters, assembly halls, gymnasiums and similar occupancies having a ceiling height of less than fifteen (15) feet, the total air movement shall be based on seven and one-half (7½) air changes per hour.

M-317.4.2 To avoid deflecting the curtain, the stage in any theater or assembly hall for which a fire curtain is required shall be supplied with sufficient air to equalize the pressure.

M-317.4.3 Heating and ventilating systems installed in so-called community buildings and lodge halls may be arranged for selective delivery of the entire service to any area, provided these areas are not used simultaneously.

M-317.5 **Motion picture booths:** This classification shall include all motion picture booths housing projection equipment using carbon arc lamps.

M-317.5.1 Fumes, gases and other harmful contamination shall be effectively removed by mechanical exhaust ventilation directly from their source, including projectors, spot lights, stereopticons and similar equipment, and discharged to the outside air. An exhaust system(s), including the exhaust unit and connecting ducts, shall be arranged to serve all the sources of harmful contamination in such booth area. The capacity of the exhaust system shall be at least fifteen (15) cubic feet per minute (cfm) for each arc lamp or other source of contamination. Dampers shall not be installed in such a system, and it shall be entirely independent of any other system serving the building.

M-317.5.2 In every booth or room which is required to have a mechanical exhaust system, provisions shall be made for a supply of fresh tempered outside air to replace the air exhausted.

M-317.6 **Places of assembly for worship:** This classification shall include auditoriums, social assembly rooms, Sunday school rooms and similar areas which are contained in churches or houses of worship. It shall also include chapels used in connection with funeral homes, as well as those in parochial schools, convents and similar occupancies.

M-317.6.1 The air movement, outside air supply and air distribution for all occupancies under this classification shall conform to the requirements of Section M-317.3, except that mechanical ventilation will not be required where the total openable area of the outside windows is greater than one-twentieth (1/20) of the floor area served, except that in funeral homes the openable area of the outside windows shall be greater than one-tenth (1/10) of the floor area served. Such window openings shall preferably be all above grade. Window openings below grade shall not be considered, unless there is a clear space outside of the windows having a width of at least one and one-half (1½) times the distance below grade at the bottom of the window. Width shall mean the horizontal distance measured at right angles to the plane of the window.

M-317.6.2 Heating and ventilating systems installed in occupied areas of this class may be arranged for selective delivery of the entire service to any area, provided these areas are not used simultaneously.

M-317.7 **Schools:** This classification shall include all class, study, recitation, lecture, project rooms, kindergartens, library reading rooms and similar areas in all school, college and library buildings used for educational purposes (see Section M-317.4 for assembly rooms and Section M-317.8 for laboratories).

M-317.8 **Places for vocational instruction and research:** This classification shall include all places for vocational instruction and research, such as laboratories, school shops, domestic science rooms and similar occupied areas.

M-317.8.1 The air movement and outside air supply for all occupancies under this classification shall conform to the requirements of Section M-317.3.

M-317.8.2 An exhaust ventilating system shall be provided in connection with all equipment and processes which create any dust, fumes, vapors or gases which may be injurious to health.

M-317.8.3 Exhaust systems serving this classification shall be separate from, and independent of, all other services and systems in the building.

M-317.9 **Wardrobes and locker rooms:** This classification shall include all wardrobes, cloak rooms, lockers, locker rooms and similar areas in all buildings within the scope of this code, except as noted herein.

M-317.9.1 Ventilation shall be provided and maintained for all areas of this class. Wherever practicable, such ventilation shall be accomplished by exhaust methods, and in any case, the effectiveness of the exhaust shall be greater than that of the supply.

M-317.9.2 The air movement provided and maintained for areas of this class shall be at least two (2) cubic feet per minute (cfm) per square foot of floor area when this area or adjacent areas are occupied.

M-317.9.3 Where necessary in order to insure practical results in wardrobes or cloak rooms in school buildings, adjacent to, or connected with, occupied areas covered by Section M-317.7, the required ventilation shall be accomplished by use of inlets admitting air from adjacent classrooms, corridors or similar areas, in conjunction with outlets and ducts discharging direct to outside atmosphere.

M-317.9.4 Locker rooms in conjunction with toilet, bath and swimming rooms and located in this classification shall be required to have a tempered outside air supply which may be exhausted through the adjoining toilet, shower or swimming room.

M-317.9.5. In places of industrial employment where locker rooms are required, a tempered outside air supply shall be provided for the locker rooms and may be exhausted through the adjoining toilet or shower room.

M-317.9.6 In first aid rest rooms in places of employment, ventilation shall be provided and maintained for all areas of this class to conform with the requirements of Section M-317.3 unless the openable area of windows shall equal at least five (5) per cent of the floor area of the room.

M-317.10 **Toilets, janitor closets, sterilizing and swimming rooms:** This classification shall include all toilet, bath and swimming pool rooms, janitor closets and sterilizing rooms.

M-317.10.1 Ventilation shall be provided and maintained for all areas of this class. Such ventilation shall be accomplished by exhaust methods with the effectiveness of the exhaust greater than that of the supply. For multiple shower installations, a mechanical exhaust shall be provided, unless the room has a direct positive air supply, in which case the exhaust may be gravity.

M-317.10.2 Every toilet room shall be provided with gravity or mechanical exhaust ventilation.

M-317.10.3 The air exhausted from toilet rooms, hospital janitor closets and sterilizing rooms shall be at least two (2) cubic feet per minute (cfm) per square foot of floor area.

M-317.10.4 The air recirculated in swimming pool areas shall be at least six (6) air changes per hour, and the tempered outside air supplied and exhausted shall be at least two (2) cubic feet of air per minute per square foot of pool surface.

M-317.10.5 Exhaust systems serving this class of occupancy shall be separate from, and independent of, all other services and systems in the building, unless otherwise approved by the department.

M-317.11 **Offices:** This classification shall include all offices and similar occupied areas wherein the air conditions and nature of occupancy do not involve reasonable inclusion in any other classification in this code.

M-317.11.1 The air movement, outside air supply and air distribution for all occupancies under this classification shall conform to the requirements of Section M-317.3, unless the following requirements have been satisfied:

1. the total openable areas of outside windows shall be at least one-twentieth (1/20) of the floor area served:
2. the available floor space for each occupant shall be at least one hundred (100) square feet per person; and
3. heat or odors are not present in sufficient quantities to be injurious to health, safety or welfare.

M-317.12 Retail establishments: This classification shall include barber shops, beauty parlors, brokerage board rooms, taverns, bowling alleys and all retail establishments where goods and commodities are bought and sold, and places where not more than fifty (50) persons assemble for recreation, entertainment or dining purposes.

M-317.12.1 The air movement, outside air supply and air distribution for all occupancies under this classification shall conform to the requirements of Section M-317.3 unless the total openable area of outside windows is more than one-twentieth (1/20) of the floor area served, provided such outdoor openings are arranged so as to cause air circulation throughout. Windows or outdoor openings which are below grade shall not be considered unless a clear space is provided outside the window, having a width of at least one and one-half (1½) times the distance the bottom of the window is below grade. By width is meant the horizontal distance measured at right angles to the plane of the window.

M-317.13 Garages: Ventilation shall be provided for this classification which shall include all repair garages, service stations, body shops and all storage garages housing five (5) or more vehicles driven by internal combustion engines. A storage area is defined as any area within a building used for the storage of fire trucks, tractors, automobiles, trucks and other self-propelled vehicles driven in and out under their own power. The outside air supply and exhaust ventilation shall be provided and maintained for all occupied areas in this classification during periods of occupancy.

M-317.13.1 Areas used for the storage of five (5) or more motor-driven vehicles, and where heat is provided, shall be provided with a tempered supply of outside air of at least three-fourths (¾) cubic foot per minute (cfm) per square foot of floor area. Necessary vents shall be provided to exhaust the outside air supplied.

M-317.13.2 Areas used for the storage of five (5) or more motor-driven vehicles, and where heat is not supplied, shall be provided with exhaust ventilation based on three-fourths (¾) cubic foot of air (cfm) per minute per square foot of floor area, unless the following requirements have been satisfied. The floor shall be at or above grade level. Permanent open wall of the included area shall be at least fifty (50) per cent of the total wall area and shall be provided on opposite sides to cause air circulation throughout the respective area.

M-317.13.3 All areas in which the repairing of motor-driven vehicles is done shall be provided with a tempered supply of outside air at least three-fourths (¾) cubic foot per minute (cfm) per square foot of floor area and with the necessary vents for exhausting the same volume of air from a point at the floor level. A mechanical exhaust system shall be provided in the repair area to remove the exhaust fumes from the internal combustion engines. The duct system shall be designed with sufficient outlets to provide for the total number of vehicles in the repair area. Flexible hose shall be provided which shall be equipped with a device for connecting it to the exhaust pipe of the vehicle and the exhaust system. Each outlet shall be provided with a shut-off device which may be closed when not in use.

M-317.13.4 Service stations shall include liquid fuel-dispensing stations where vehicles can be driven into the building for washing, greasing, oil change, tire or battery replacement and similar operations. All service room or work room areas shall be provided with a tempered supply of outside air of at least one-half (½) cubic foot per minute (cfm) per square foot of floor area and with the necessary gravity vent or vents exhausting the same volume of air from a point at the floor level.

M-317.13.5 A separate ventilating system shall be provided for show rooms or offices, where such occupancies are located adjacent to repair or storage areas and would require ventilation in accordance with Section M-317.3. This requirement does not apply to service stations. This shall not be construed to preclude using exhaust air from the show room and office to the repair or storage area.

M-317.13.6 There shall not be recirculation of air from any repair, storage or service area during periods of occupancy, except where the total amount of air in circulation is in excess of the quantity required by this code, the excess air may be recirculated.

M-317.13.7 The air that is mechanically exhausted from the repair, storage, and service areas in a building shall be removed at a point at the floor through properly distributed vent ducts located in areas of greatest contamination.

M-317.13.8 The products of combustion, vapors, gases and fumes from fuel or batteries shall be removed promptly and effectively.

M-317.14 Ventilation of service stations inside buildings

M-317.14.1 Vapors shall be withdrawn from the enclosure in which they are generated and taken to the outside of the building in the most direct manner practicable.

M-317.14.2 Vapors shall be removed through a system of ducts. Inlets shall be located to produce a sweeping or purging effect that will tend to avoid pockets in which vapors may accumulate. Exhaust openings shall be located at the floor line.

M-317.14.3 A gasoline vapor sampling device shall be installed at the intake opening of the ventilating exhaust ducts and shall be equipped with an approved audible alarm. Such device shall be set to operate at twenty-five (25) per cent below the lower explosive limit.

M-317.14.4 Fuel-dispensing pumps shall be interlocked with the ventilating fans so that the pumps cannot operate until fans have been on for at least one (1) minute.

M-317.14.5 Fans shall be located on the discharge end of the ducts, and the ducts shall be electro-statically grounded.

M-317.14.6 Ducts shall be covered with at least one (1) hour fireresistance rated material.

M-317.14.7 Both supply and exhaust facilities shall be such as to provide at least twelve (12) air changes per hour.

M-317.14.8 Fan controls shall be installed on the outside of the enclosure near an entrance door unless fully explosion-proof and approved.

M-317.14.9 The ventilating system shall be independent of all other ventilating, cooling or heating systems.

M-317.14.10 **Power and control:** See the electrical code of this jurisdiction.

M-317.14.11 Fans shall be of noncombustible construction and of adequate capacity to properly perform the functions required. Fans shall be so located and arranged as to afford ready access for repairing, cleaning, inspection and lubricating. They shall be placed on proper foundations or firmly secured to substantial supports. The rotating element shall be of non-ferrous or non-sparking material, and the casing shall consist of, or be lined with, such material. Housing or casing shall be of substantial construction to prevent distortion and loss of alignment under operating conditions. Blades or impellers and shafting shall be sufficiently strong and designed with adequate clearance to prevent contact with casings or prevent distortion under conditions of deposit loading or other factors. Exposed openings into housing shall be protected with substantial metal screen or gratings to prevent accidents or the entry of foreign material. Bearings shall be constructed and shall be so proportioned, secured and aligned as to prevent overheating. Bearings shall be accessible for lubrication and shall be well desgined to prevent leakage of oil and minimize dust infiltration. They shall be located outside of casings and ducts, unless proper shielding and dust-proofing is provided.

M-317.14.12 Ducts: Ducts shall be constructed entirely of sheet metal or other noncombustible material, and of adequate strength and rigidity to meet the conditions of service and installation requirements, and shall be properly protected where subject to mechanical injury. All ducts shall be made tight throughout and shall not have openings other than those required for the proper operation and maintenance of the system. All ducts shall be thoroughly braced where required and substantially supported by metal hangers or brackets. The supports shall be designed to afford strength and rigidity against vibration. All laps in the ductwork shall be made in the direction of the air flow. Changes in size of ducts shall be by means of a taper transition piece.

When ducts or outlets to or from them pass through fire walls or fire-rated partitions, they shall be equipment with approved fire dampers in accordance with Section M-301.11. Where ducts pass through walls, floors or partitions, the space around the duct shall be fire-stopped with an approved noncombustible material.

Access openings for damper, sprinkler or fusible link inspection or resetting, and for residue clean-out purposes, shall be equipped with tight fitting sliding or swinging doors provided with substantial latches, except in the case of vertical sliding doors held in place by gravity. All duct systems operating at approximately room temperature shall have a clearance of at least six (6) inches from any combustible material. Ducts shall not be built into the walls of a building or structure. Dampers, valves and shutters in this type of system shall not be installed, except where necessary at outlets to afford weather protection when the system is shut down or where such devices are used for the final balancing of the exhaust system. In such cases, the dampers shall be securely locked to prevent further manipulation. Ducts shall be so constructed as to provide structural strength and stability equivalent to at least the thickness given in Table M-319.2.1 of this article. Dissimilar matter shall not be handled through one (1) exhaust system when the intermingling or contact of one type of material with another would create a fire or explosion hazard in the duct system, collection unit or air flow-producing equipment. Operations generating sparks, such as from hot materials or grinding wheels, shall be connected to a separate exhaust system.

M-317.14.13 Outlets: Outlets to the atmosphere shall be kept clear of, and away from, any combustible material, and their location shall be subject to the approval of the department, in the interests of the public health and safety.

M-317.15 Places of employment: This classification shall include all places of employment not classified elsewhere in this code.

M-317.15.1 The air movement, outside air supply and air distribution for all occupied areas under this classification shall conform to the requirements of this article, unless all of the following requirements have been satisfied. The available floor space for each occupant shall not be less than one hundred (100) square feet per person. Heat, smoke, gas, dust, spray, hazardous fumes, vapors, steam or other contamination shall not be present in the air in sufficient quantities to obstruct the vision or to be irritating or injurious to health, safety or welfare. The total openable area of outside windows shall be at least one-twentieth (1/20) of the floor area served. This requirement does not apply to refrigeration plants, warehouses, cold storage buildings and processing areas, where the nature of the occupancy would not permit outdoor openings unless internal combustion engines are operated within and not separately ventilated.

M-317.16 Penal institutions and places of detention: This classification shall include corridors and areas of compulsory occupancy in penal institutions, mental hospitals and other places of detention.

M-317.16.1 The air movement outside air supply and air distribution for all occupancies under this classification shall be accomplished by mechanical means and shall conform to the requirements of Sections M-317.2 and M-317.3. The air movement through the corridors shall be a minimum of ten (10) cubic feet per minute (cfm) per lineal foot of corridor.

M-317.16.2 Where cells are provided for not more than six (6) occupants for the purpose of overnight detention only, exhaust ventilation shall be provided on the basis of six (6) air changes per hour for the occupied area. This air shall be tempered and may be taken from adjacent areas.

M-317.17 Hospitals: This classification shall include hospitals, nursing homes, public health centers, treatment centers and similar occupancies where professional medical services are provided for treatment and care of patients.

M-317.17.1 The air movement, outside air supply and air distribution shall conform to the following requirements described in Sections M-317.17.1 through M-317.17.6.

M-317.17.2 Exhaust ventilation shall be provided from bedpan rooms, baths, janitor closets, sterilizing rooms and laboratories on the basis of two (2) cubic feet per minute (cfm) for each foot of floor area.

M-317.17.3 Drug storage rooms, utility rooms, treatment rooms, dark rooms and X-ray rooms shall have a minimum air movement of six (6) air changes per hour, unless the total openable window area is one-twentieth (1/20) of the floor area served. Such ventilation shall be accomplished by exhaust methods.

M-317.17.4 The recovery rooms, labor rooms and nursery shall have a minimum air movement of at least six (6) air changes per hours. Tempered outside air shall be provided, and the system shall be designed to maintain a room temperature of seventy-five (75) degrees F. The recirculation of air is not permitted except in a nursery, where a part of the air may be recirculated from the area supplied. Mechanical exhaust ventilation equal to the volume of air supplied shall be provided.

M-317.17.5 Mechanical ventilation of anesthetizing locations, operating rooms, delivery rooms and rooms used for similar purposes shall be provided and shall be in full operation during room use. Ventilation systems shall be so designed as to provide a slight excess of air supplied over that exhausted, so balanced that the pressure in the operating room is positive but not sufficient to create a dispersal of combustible anesthetic agents or create possibilities of cross-infection. Air shall be supplied to the room through one (1) or more inlets located so that the air will be uniformly distributed and not cause a draft on any person near the operating table. Air shall be exhausted by one (1) outlet if possible. The bottom of such outlet shall be located not more than seven (7) inches above the floor and as near as practicable to the planned location of the anesthesia machine or the head of the surgical table. The exhaust outlet shall rest on the top of the baseboard if there is one in the room. Ceiling inlets or inlets in the same wall as the exhaust outlet are permitted. Tempered outside air shall be provided, and the recirculation of air is not permitted. These locations shall be provided with humidity control equipment of sufficient capacity to maintain relative humidity of fifty-five (55) per cent plus or minus five (5) per cent of the temperature of the room. It is mandatory that the equipment provide for a room temperature in a range of sixty-eight (68) degrees F. to eighty (80) degrees F., with controls for selecting any desired temperature within this range.

M-317.17.6 Private, semi-private wards and day rooms shall be ventilated in accordance with the requirements of Section M-317.3, and recirculation of air between rooms shall be avoided.

M-317.18 **Passages (enclosed) for vehicles using internal combustion engines:** If passage has two (2) openings, one (1) in each end wall of the passage and exposed to the atmosphere, and each having an area not less than twenty-five (25) per cent of the cross-sectional area of the passage, mechanical ventilation is not required. If openings having a combined area not less than fifty (50) per cent of the area of a side wall of the passage, uniformly distributed and provided to atmosphere, mechanical ventilation is not required.

M-317.19 **Smokeproof enclosure (vestibule) ventilation:** The vestibule of all smokeproof enclosures shall be provided with ventilation as required by the building code.

M-317.20 **Ventilation of dry cleaning plants utilizing non-flammable solvent:** In addition to the requirements of this article, dry cleaning plants utilizing non-flammable solvents shall provide ventilation in accordance with the following Sections M-317.20.1 through M-317.20.3.

M-317.20.1 The dry cleaning equipment shall be provided with an exhaust system capable of maintaining a minimum of one hundred (100) feet per minute face velocity through the loading door, whenever the door is in fully open position. The ductwork connections of such system shall be sealed (soldered or taped), and the discharge stack shall extend through the roof to a height of at least eight (8) feet above such roof. Where a parapet wall is present, such exhaust stack shall project at least three (3) feet above such parapet. This exhaust stack discharge shall in all cases be a minimum of ten (10) feet from a window, opening or fresh air intake. Prior to installation of such exhaust stack, consideration shall be given to the proximity of adjacent buildings or structures or other equipment located on the roof.

M-317.20.2 Coin operated plants: The air flow volume shall be at least that required by Table M-317, with air movement through a curtain wall. For the purpose of this section, the curtain wall is the division partition between the public area and the service area. The direction of air flow shall be from the public area to the service area. Air flow openings shall be provided in the curtain wall or in the machines at or near the floor level. Additional openings may be provided. If the equipment as installed does not maintain this volume, an auxiliary fan shall be provided in the service area.

M-317.20.3 Other type cleaning plants: Air supply shall be provided to the public area and mechanically exhausted from the working area (service area). The requirements shall be a minimum rate as required by Table M-317.

M-317.21 Range hoods and fans in non-commercial occupancies

M-317.21.1 Where range hoods and fans are provided, air shall be removed from kitchens by a range hood or a wall or ceiling fan.

M-317.21.2 All ducts from exhaust fans shall discharge to outdoor air. Ductwork shall be designed for shortest practical run to the exterior.

M-317.21.3 When the kitchen is not provided with required natural ventilation, mechanical ventilation shall be provided in the ceiling or wall close to the range and not more than four (4) feet (measured) from the center line of the range off the side or front of the range or in the wall directly above the range between wall cabinets and range, provided a metal collector is installed.

M-317.21.4 When the kitchen is provided with required natural ventilation and a wall or ceiling fan is installed as an optional item of equipment, wall or ceiling fan grills shall be located in accordance with Section M-317.21.3, except that ceiling or high wall fans may be located not more than six (6) feet (measured from center line of range) off side or front of range. Metal collector hood is not required for low wall fans between range and wall cabinets. Hoods using charcoal for filtering are prohibited. Unvented and electro-static type hoods are prohibited.

Table M-317
OCCUPANCY VENTILATION CLASSIFICATION

Use of occupancy	Use classification*	Section reference
Arenas and field houses	I	M-317.4
Armories (drill halls)	I	M-317.4
Assembly halls	I or II	M-317.4 & M-317.12
Banquet halls	I or II	M-317.4 & M-317.12
Barber shops	II	M-317.12
Bath and shower rooms	III	M-317.10
Beauty parlors	II	M-317.12
Billiard rooms	I or II	M-317.4 & M-317.12
Bowling alleys	I or II	M-317.4 & M-317.12
Brokerage board rooms	I or II	M-317.12
Cafeterias	I or II	M-317.4 & M-317.12
Churches and other places of worship	II	M-317.6
Sunday school rooms	II	M-317.6
Club Rooms (depends on usage)	I or II	M-317.4
Dance halls	I or II	M-317.4 & M-317.12
Dining rooms	I or II	M-317.4 & M-317.12
Dry cleaning plants	III	M-317.20
Factories and machine shops	II	M-317.15
First aid rest rooms	I or II	M-317.9
Foundries and boiler shops	II	M-317.15
Funeral homes	II	M-317.6
Garages and service stations	IV	M-317.13 & M-317.14
General offices	I or II	M-317.11
Gymnasiums and combined gymnasiums and assembly halls	I	M-317.4
Hospitals	I or II	M-317.17
Janitor closets	III	M-317.10 & M-317.17
Kitchens (non-commercial)	III	M-317.21
Laboratories	I or III	M-317.8
Laundries	III	M-317.4 & M-317.12
Lecture halls	I	M-317.4 & M-317.12
Library reading rooms	I	M-317.7
Locker rooms	III or IV	M-317.9
Lodge halls	I or II	M-317.4 & M-317.12
Mental hospitals	I or II	M-317.16

Table M-317 (cont'd)
OCCUPANCY VENTILATION CLASSIFICATION

Use of occupancy	Use classification*	Section reference
Motion picture booth	I or III	M-317.5
Passages (automobile)	III	M-317.18
Penal institutions	I or II	M-317.16
Places of employment	II	M-317.15
Play room (unfurnished areas)	III	M-317.4 & M-317.12
Printing establishments	II	M-317.15
Residential	IV	See building code
Restaurants	I or II	M-317.4 & M-317.12
Retail establishments	I or II	M-317.12
School all-purpose, dining, and recreation rooms	I	M-317.4, M-317.7 & M-317.12
School auditoriums	I	M-317.4 & M-317.7
School classrooms	I	M-317.7
School kindergarten rooms	I	M-317.7
School lecture rooms	I	M-317.7
School project rooms	I	M-317.7
School study rooms	I	M-317.7
Skating rinks	I or II	M-317.4 & M-317.12
Smokeproof towers	III	M-317.19
Spray painting and dipping	III	M-317.22
Swimming pools	III	M-317.10
Taverns	I or II	M-317.12
Theaters	I	M-317.4 & M-317.12
Theater lobbies	I	M-317.4 & M-317.12
Theater lounge rooms	I	M-317.4 & M-317.12
Toilet rooms	III	M-317.10
Vocational instruction and research	I or II	M-317.8
Wardrobes, lockers and cloakrooms	III	M-317.9

The ventilating requirements for rooms used for purposes similar to those enumerated in the foregoing table, but not specifically named therein, shall be the same as those for room purposes of similar character.

*Use Classification (see Section M-317.2):
Use Class I. Require ventilation on an occupancy basis.
Use Class II. Require ventilation on an occupancy basis unless otherwise exempted.
Use Class III. Require exhaust.
Use Class IV. Require ventilation on the basis of floor area.

M-317.22 Spray painting and dipping rooms and booths

M-317.22.1 Spray painting and dipping rooms and booths shall be provided with adequate ventilation in the following manner indicated in Section M-317.22.2.

M-317.22.2 The minimum cross-sectional velocity measured across direction of air flow for spray paint and dipping rooms and booths shall be one hundred (100) feet per minute (fpm). The spraying operation shall be across or with the air stream if accomplished within five (5) feet of the air inlet opening. Any opening, other than air supply opening, shall be electrically interlocked so as to prevent operating of spray equipment until such openings are closed. Air exhausted from the booth or room shall be replaced with air of equal volume and temperature. If air supply is taken from the adjoining space, such air shall be replaced with a like volume of equal temperature air. The compressed air supply to spray painting equipment shall be interlocked with the ventilation and makeup air equipment and shall also be interlocked with the water-wash equipment, if any, to assure the operation of such equipment during spraying operations. When replacement air is tempered through a direct fired unit, the design of the system shall be of the after mixed method, so that inlet air temperatures to the heat exchanger is at least fifty (50) degrees F. The air inlet opening shall be located so as to provide uniform sweep of air throughout the entire room toward the exhaust opening or openings. Vents of the dry filtered type shall be directed by use of an inverted U-bend with discharge directed downward into a metal pan on the roof three (3) inches in depth and shall extend at least twelve (12) inches on all sides of such outlet. The method of exhaust venting shall not constitute a nuisance or hazard to adjoining property or to the public.

M-317.22.3 Freshly sprayed articles shall be dried only in spaces provided with adequate ventilation to prevent the formation of explosive vapors. In the event adequate and reliable ventilation is not provided, such drying spaces shall be considered a spraying area as herein defined.

SECTION M-318.0 FANS AND BLOWERS

M-318.1 General: All blowers and fans shall bear the label of a nationally recognized testing or inspection agency.

SECTION M-319.0 BLOWER AND EXHAUST SYSTEMS FOR REMOVING DUST, STOCK, AND VAPORS (EXCLUDING PAINT SPRAY ROOMS AND BOOTHS AND SINGLE FAMILY OCCUPANCY)

M-319.1 General: Blower and exhaust systems for dust, stock or vapors hereafter installed as part of, or attached to parts of, a building shall be constructed and installed to conform to the requirements of this article and generally accepted standards (see also Article 11).

M-319.1.1 Air exhausted shall be replaced with tempered air of equal volume.

M-319.2 Ducts

F-319.2.1 Ducts shall be constructed of steel or iron of a gauge at least that as specified in Table M-319.2.1.

Table M-319.2.1

BLOWER AND EXHAUST SYSTEMS FOR DUST, STOCK AND VAPORS: MINIMUM DUCT SIZE

Diameter of duct (inches) or maximum side (inches)	Galvanized Sheet Gage			
	Non-abrasive materials		Abrasive dusts	
	Thickness	Gage	Thickness	Gage
Up to 8, inclusive	0.028 in.	24	0.040 in.	20
Over 8 to 18, inclusive	0.034 in.	22	0.052 in.	18
Over 18 to 30, inclusive	0.040 in.	20	0.064 in.	16
Over 30	0.052 in.	18	0.079 in.	14

M-319.2.2 Changes in the size of ducts shall be made on a taper not to exceed twenty (20) degrees.

M-319.2.3 Ducts shall be made tight throughout and openings shall not be permitted except those necessary to perform the required functions of the system and to permit cleaning and servicing. Duct laps shall be constructed so as to prevent the lodging or escapement of dust, stock or vapor.

M-319.2.4 Ducts shall have noncombustible supports at intervals not to exceed eight (8) feet for other than vertical duct, and at intervals not to exceed fifteen (15) feet for vertical ducts. Hangers and brackets shall be of iron or steel.

M-319.2.5 Ducts carrying flammable vapors or dust shall have a clearance of at least eight (8) inches from combustible materials. Ducts operating at elevated temperatures shall have clearance from combustible materials in accordance with Table M-319.2.5.

M-319.2.6 Fire dampers shall not be required for exhaust systems carrying explosive or toxic gases.

Table M-319.2.5

EXHAUST DUCT MINIMUM CLEARANCES

Duct gas temperature	Largest duct dimension	Clearance
Up to 600° F., inclusive	8 in.	9 in.
	Over 8 in.	12 in.
Over 600° F. to 900° F., incl.	8 in.	18 in.
	Over 8 in.	24 in.
Over 900° F. to 1000° F., incl.	All sizes	24 in.
Over 1000° F. (Ducts shall be lined with refractory)	All sizes	24 in.

M-319.2.7 Where ducts pass through walls, floors or partitions, the space around the duct shall be sealed with noncombustible material.

M-319.3 Blowers and fans

M-319.3.1 Fans shall be of spark-resistive or explosion-resistive construction and of adequate capacity to properly perform the functions required. Blowers and fans shall be so located and installed as to be accessible for repairs, cleaning, inspecting and lubricating.

M-319.3.2 When flammable solid materials or vapors are passed through the fans, the rotating element shall be of non-ferrous or non-sparking material, or the casing shall consist of, or be lined with, such material. Where there is a possibility of solid foreign material passing through the fan that would produce a spark, both the rotating element and the casing shall be constructed as required herein and in conformance with the standards listed in Appendix B.

M-319.3.3 Exposed openings into housings shall be protected with substantial metal screens or gratings to prevent accidents or the entry of foreign material.

M-319.4 **Grounding:** All metal parts of apparatus used in systems for the removal of flammable gases or vapors or systems used for conveying flammable dust, stock or refuse shall be electrically bonded and grounded in an effective and approved manner, according to the electrical code of this jurisdiction.

M-319.5 Systems for removal of flammable or toxic vapors

M-319.5.1 In exhaust systems designed for the removal of flammable or toxic vapors, ducts shall lead to the outside of the building in the most direct manner possible. Ducts or other portions of any vapor removal system shall not extend into stories or rooms of a building other than those from which the vapor is being removed.

M-319.5.2 Outlets to the atmosphere shall be kept clear of and away from combustible materials or adjacent structures to prevent accumulation of combustible residues.

M-319.5.3 See Article 11 for further requirements.

M-319.5.4 Where heavier-than-air vapors or mixtures are handled, exhaust opening shall be located near the floor line. Conversely for vapors or mixtures lighter than air, exhaust system inlets should be located near the top of room, hood or enclosure.

M-319.6 Dust, stock and refuse conveying systems

M-319.6.1 These systems shall consist of suction ducts and inlets, air-flow producing equipment, feeders, discharge ducts and outlets, collecting equipment, vaults and other receptacles designed to collect by air or gas, powdered, ground or finely divided material.

M-319.6.2 Systems collecting highly flammable or explosive dust shall be so arranged that the fan is on the clean air side of the collector.

M-319.6.3 Conveying systems for cotton and similar textile materials which are readily ignitable shall be arranged so as not to create suction in machines producing the material.

M-319.6.4 Rooms or bins into which readily ignitable material is discharged by a collecting or conveying system shall be of noncombustible material. Such rooms or bins shall be provided with ventilating ducts leading to the outside of the building.

M-319.6.5 Dust collecting systems from grinding and other machines which may produce sparks shall not be combined with collecting systems handling lint or other readily flammable dusts.

M-319.6.6 Approved magnetic separators of the permanent magnet or electromagnetic types shall be installed at those points where combustible materials, which may contain ferrous particles, enter the system. The separators shall be of sufficient size to insure the removal of all ferrous material passing over them.

M-319.6.7 Metal ducts shall be constructed of sheet steel of not less than the gauges shown in Table M-319.2.1. All sheet metal elbows and bends shall be made from material at least (2) gauges heavier than is required for straight duct-work of the same diameter, except that when No. 14 Manufacturers' Standard Gage (0.075 inch) or thicker, the elbows and straight duct-work may be of the same gauge. Round sheet metal elbows shall have a throat radius equal to one-half (½) to two (2) times the duct diameter unless space prohibits the use of such long bends. In place of long radius elbows specified above, rectangular elbows, venturi-low-resistance design, may be used. Every duct shall be kept open and unobstructed throughout its length, and a screen shall not be placed in it. Additional branch ducts shall not be added to an existing system without redesigning the system. Branch ducts shall not be disconnected, nor shall an unused portion of a system be blanked off without providing orifice plates to maintain required air-flow.

M-319.6.8 Cleanout openings shall be provided at a maximum of twenty (20) foot intervals in ducts when the smallest dimension of the duct is less than eighteen (18) inches. Such cleanouts shall be not less than two (2) inches smaller in diameter than the smallest dimension of the duct in which they are installed. Removable grilles of equivalent size may be used in lieu of such openings.

M-319.7 Separating and collecting equipment

M-319.7.1 This shall include cyclones, condensers, cloth screen and stocking arrestors, centrifugal collectors and other devices used for the purpose of separating solid material from the air stream in which it is carried and hoppers, bins, silos and vaults for collecting the solid material so separated.

M-319.7.2 Separating and collecting equipment shall be designed and constructed to withstand explosion pressures, due consideration being given the reduction in pressure afforded by adequate explosion relief vents.

M-319.7.3 Separating or collecting equipment shall be so located as to not constitute a hazard to adjacent structures. Their construction shall be of steel. Supports shall be of steel, masonry or concrete and the structure securely anchored to resist anticipated wind pressures. Cleanout doors shall be provided. Separating or collecting equipment shall be located at a safe distance from combustible construction or unprotected openings into buildings.

M-319.7.4 Discharge ducts shall not come in contact with, nor expose, combustible material and should terminate above the roofs [if within ten (10) feet] of buildings of combustible construction or unprotected openings.

M-319.7.5 Delivery ducts from cyclone collectors should not convey refuse directly into the fireboxes of boilers, furnaces (including dutch ovens), refuse burners, incinerators, etc.

M-319.8 Explosion relief vents

M-319.8.1 Explosion relief vents shall be provided on all duct systems used for conveying materials which form an explosive mixture with air. Explosion vents shall have a cross-sectional area not less than the cross-sectional area of the duct vented. Vents shall be provided where direction of flow is changed and at the maximum elevation in the system.

M-319.8.2 Explosion relief vents shall not be connected to chimneys or duct systems used for other purposes.

SECTION M-320.0 COMMERCIAL COOKING APPLIANCES

M-320.1 **Clearance:** Commercial cooking appliances shall have a clearance vertically above the top of at least thirty-six (36) inches to combustible material. Where casters are provided on commercial cooking appliances, the clearance from the rear and sides of the appliance shall be six (6) inches to combustibles. Where casters are not provided, the clearance from the rear and sides of the cooking appliance to combustibles shall be eighteen (18) inches.

> **Exception:** Listed appliances may be installed in accordance with their listing.

M-320.2 Installation

M-320.2.1 All commercial cooking appliances shall be installed in an accessible location and shall comply with Article 6.

M-320.2.2 The use of liquefied petroleum gas or liquid fuel is prohibited unless approved by the department.

SECTION M-321.0 COMMERCIAL HOODS AND FANS

M-321.1 Required Locations: Commercial cooking appliances, such as restaurant-type ranges, deep fat fryers, broilers, roasting ovens, candy kettles, cruller furnaces and other commercial and industrial appliances that present a fire hazard similar to commercial frying operations, shall be provided with ventilating hoods and exhaust ducts. Range hoods and fans shall conform to the requirements of this section. Domestic ranges used for commercial purposes shall meet the requirements of this section.

M-321.2 Fire suppression system: See Section M-1003.21.

M-321.3 System designs

M-321.3.1 The system shall be so designed as to confine cooking vapors and residues within the hood or other primary collection means installed at the cooking appliances.

M-321.3.2 The hood or other portion of the system designed for primary collection of cooking vapors and residues shall be constructed of steel or stainless steel with liquid-tight joints and shall have a clearance of at least eighteen (18) inches to combustible material.

M-321.3.3 Duct systems shall be designed to create a conveying air velocity in the exhaust ducts of at least that specified in Section M-317.10.1.

M-321.3.4 Exhaust systems shall be provided with grease filters or grease retention elements conforming to Sections M-324.3.1 to M-324.3.5.

M-321.3.5 Grease filters or other means of grease extraction shall be of noncombustible construction designed for the specific purpose. The height of lowest edge of grease filters located above the cooking surface shall not be less than the following:

1.	without exposed flame (grills, french-fryers, etc.)	2½ feet
2.	exposed charcoal and charcoal-type fires	4 feet
3.	exposed fires other than Item 2	3½ feet

M-321.4 Exhaust ducts and hoods

M-321.4.1 Ducts shall be constructed of No. 16 Manufacturers' Standard Gage (0.060 inch) or heavier steel, or No. 18 United States Standard Gage (0.050 inch) or heavier stainless steel, with liquid-tight joints. Inside laps on duct joints shall project in a direction against the air flow. Hoods and other primary collection devices shall be constructed of No. 18 Manufacturers' Standard Gage (0.048 inch) or heavier steel or No. 20 United States Standard Gage (0.037 inch) or heavier stainless steel.

M-321.4.2 Ducts shall lead as directly as possible to the outside and be so constructed as to provide suitable drainage of grease to a collection point.

M-321.4.3 Ducts shall constitute an independent exhaust system leading to the outside and shall not be connected with any other exhaust system.

M-321.4.4 Hand-holes for inspection and cleaning purposes, equipped with tight-fitting sliding or swinging doors and latches, shall be provided in horizontal sections of exhaust ducts. Such openings shall be at the sides of the horizontal run in order to prevent dripping of residue. Spacing of such openings shall not exceed twenty (20) feet. Openings shall have a minimum dimension of twelve (12) inches.

M-321.4.5 Vertical risers shall be located outside of the building and adequately supported with noncombustible supports. When approved by the department, a riser may be located inside the building, in which case, the riser shall be enclosed in a fireresistive shaft in accordance with the provisions of the building code. Access openings shall be provided in the enclosure at each cleanout point. A minimum of six (6) inches shall be required between fireresistive shaft and exhaust duct.

M-321.4.6 At the base of each vertical riser, a residue trap shall be provided with provisions for cleanout.

M-321.4.7 Exhaust ducts shall not pass through fire rated walls. Where ducts pass through partitions or walls of combustible construction, the clearance shall be eighteen (18) inches. See Table M-319.2.5.

M-321.4.8 Range hood exhaust systems shall have a bypass duct on the roof, with a weatherproof relief outlet and fusible link damper at the exhaust fan inlet. The damper shall be so arranged to close the exhaust fan inlet and divert hot gases and fumes to the relief outlet in the event of a fire.

> **Exception:** Exhaust systems with approved range hoods equipped with fire dampers at the hood.

M-321.4.9 Where dampers are installed, they shall be installed to shut down the fan motor upon the automatic or manual closing of the damper. Dampers shall not be adjustable to any position except fully opened or fully closed. Dampers shall be readily accessible for inspection and cleaning.

M-321.5 **Exhaust fans:** Exhaust fan motors installed in venting systems shall be located outside of the air stream.

M-321.6 Clearance

M-321.6.1 Exhaust ducts from range hoods shall have at least eighteen (18) inches clearance from all combustible materials. Clearance may be reduced in accordance with the applicable standards listed in Appendix B.

M-321.6.2 Range hood mounting surfaces shall be provided with a minimum of five-eighths (⅝) gypsum board or equivalent protection for combustible materials.

M-321.7 **Electrical equipment and control:** See the electrical code of this jurisdiction.

M-321.8 Inspection and cleaning

M-321.8.1 The entire exhaust system shall be cleaned as needed to remove deposits of residue and grease in the system. Thorough cleaning of ducts, hoods and fans shall require scraping, brushing or other positive cleaning methods.

M-321.8.2 Periodic inspection shall be made on the entire exhaust system to determine compliance with Section M-321.8.1.

M-321.9 Ventilation for restaurant cooking equipment

M-321.9.1 Duct systems shall be designed to create a conveying air velocity in the exhaust ducts of not less than fifteen hundred (1500) feet per minute (fpm) and not more than twenty-two hundred (2200) feet per minute (fpm).

M-321.9.2 The design of the hood shall be such as to adequately collect and exhaust air, fumes, smoke and vapor from the area in which the hood is installed. Such hoods shall be equipped with mechanical exhaust blowers which exhaust a minimum of one hundred (100) cfm per square foot of hood area when the hood is attached to a wall. When the hood is located where all four (4) sides are exposed (center of room installations), a minimum of one hundred fifty (150) cfm of air per square foot of hood area shall be exhausted. Sufficient outside air shall be provided so that blowers in the kitchen area are adequately ventilated. Such air shall be approximately the same temperature as the air in the building or structure. Minimum overhang shall be three (3) inches per foot of height from the top of the appliance, and the total shall not be less than six (6) inches.

M-321.9.3 Low sidewall range-hoods, where the intake is within three (3) feet of the cooking surface, shall have a minimum volume of three hundred (300) cfm per lineal foot of cooking surface. The maximum setback from the face of the hood to edge of cooking equipment shall be one (1) foot.

M-321.9.4 Air velocity shall be uniform over the entire face of the hood.

SECTION M-322.0 DOMESTIC RANGES AND PLATES

M-322.1 General: Domestic gas ranges and plates shall conform to the requirements of Article 6. Where a fan or hood is provided for domestic ranges or plates, the duct from such hood shall be carried from the fan to the exterior of the building.

SECTION M-323.0 CLOTHES DRYERS

M-323.1 Installation: Clothes dryers shall be connected to an exhaust duct in accordance with the manufacturer's recommendations. Dryer vent systems shall be independent of all other systems and shall convey the products of combustion and/or moisture to the outside. Gages of vent materials shall be in accordance with Table M-301.4.

M-323.2 Venting

M-323.2.1 Dryer vents shall be adequately installed and shall be galvanized steel or aluminum with a minimum diameter as recommended by the manufacturer. The diameter shall be not less than the outlet of the appliance.

M-323.2.2 An accessible cleanout shall be provided at the base of each vertical riser.

M-323.2.3 When flexible exhaust ducts are installed, they shall be a part of a manufacturer's approved exhaust kit and shall be installed in accordance with the manufacturer's instructions. Connections to the dryer and to the vent terminal shall be made with an approved draw band.

M-323.3 Multiple installations

M-323.3.1 Venting systems serving more than one (1) dryer shall be designed in accordance with the manufacturer's recommendations.

M-323.3.2 Exhaust fan motors, installed in venting systems, shall be located outside of the air stream.

M-323.3.3 The fan shall operate continuously or be interlocked to operate when any individual unit is operating.

M-323-3.4 Installations exhausting more than two hundred (200) cubic feet per minute (cfm) shall be provided with makeup air to avoid a negative pressure condition, unless as otherwise approved by the department.

M-323.4 Commercial installations

M-323.4.1 Venting systems for commercial dryers shall be designed in accordance with the manufacturer's recommendations.

M-323.4.2 Exhaust fan motors installed in venting systems shall be located outside of the air stream.

M-323.4.3 Makeup air shall be provided when required to avoid a negative pressure condition.

M-323.4.4 Vent material thickness shall be in accordance with Table M-301.4.

SECTION M-324.0 FILTERS

M-324.1 Scope: This section shall apply to filters used for the filtering of air for cooling systems, heating systems, ventilating systems, range hood systems and exhaust systems. This section shall not apply to either absorption, ionizing or collecting-type filters.

M-324.2 General: Filters installed in heating, ventilating or cooling systems shall meet the following requirements of Sections M-324.2.1 through M-324.2.6.

M-324.2.1 Air filters shall be readily accessible for inspection and removal for cleaning and replacement. Duct connections shall be constructed so as to allow even distribution of the air over the entire filter-bank.

M-324.2.2 Filters installed near outside air inlets shall be protected from the weather by suitable louvers and one-half (½) inch wire mesh screen which shall be installed on the inside of the louvers and accessible for cleaning.

M-324.2.3 Air filters shall not be capable of producing large volumes of noxious products when exposed to fire.

M-324.2.4 All filters in assembly occupancies shall be approved by a nationally recognized testing or inspection agency.

M-324.2.5 Liquid adhesive coating used on air filters shall have a flash point of not less than three hundred twenty-five (325) degrees F., as indicated by ASTM D92 listed in Appendix C.

M-324.2.6 Evaporative coolers containing a combustible filter, such as excelsior (shredded paper) and water evaporation medium, are prohibited.

Exceptions: Greenhouses.

M-324.3 Filters in commercial range hoods: Such filters shall meet the following requirements described in Sections M-324.3.1 through M-324.3.5.

M-324.3.1 Commercial range hoods shall contain a grease retention element or filter which shall be placed inside the hood so that all air passing from the hood to the duct shall pass through the element or filter.

M-324.3.2 Grease retention elements or filters shall be approved by a nationally recognized testing or inspection agency. There shall be not less than one (1) square inch of filter area for each two (2) cfm exhausted.

M-324.3.3 All filter assemblies shall be accessible for easy removal of the filters for servicing or replacement.

M-324.3.4 The filter media shall be constructed of specially formed metal and shall be packed for grease retention. The filter media shall be encased in metal channel with drain holes to facilitate servicing. Each filter shall be identified by the manufacturer of the filter indicating such filter to be suitable for grease retention.

M-324.3.5 Grease filters shall be set at a minimum forty-five (45) degree angle and maximum sixty (60) degree angle from the horizontal. A cleanable grease drip pan shall be provided below the filter bank.

M-324.4 Filters (special): Filters to be used in conjunction with spray painting or dipping operations shall be nonflammable.

M-324.5 Filters (other): Filters to be used for purposes other than as provided in this section shall be approved by the department.

SECTION M-325.0 FIRE DAMPERS

M-325.1 Approval and requirements: See Section M-301.11.

SECTION M-326.0 UNDERGROUND DUCT SYSTEMS

M-326.1 Installation: Underground duct systems shall be constructed of noncombustible materials, except as provided herein, and such systems shall conform to the following Sections M-326.1.1 through M-326.1.4.

M-326.1.1 The use of organic materials is prohibited.

M-326.1.2 Underground duct systems of metal or other approved materials installed in or below concrete floors or slabs shall be fully encased in at least two (2) inches of concrete or shall be installed in accordance with the manufacturer's recommendations and shall be securely anchored every six (6) feet prior to encasement in the concrete.

M-326.1.3 Duct joints shall be securely fastened and made airtight.

M-326.1.4 Metal duct thickness shall conform with the requirements of Table M-301.4 or the standards listed in Appendix B for Duct Construction.

M-326.2 Counterflow (downflow) furnaces: When used in conjunction with an underground duct system, counterflow furnaces shall be installed in accordance with the duct work and clearance requirements of Section M-303.0 and Table M-303.

SECTION M-327.0 EVAPORATIVE COOLING

M-327.1 Location: Evaporative-type coolers shall be installed as herein required in Sections M-327.1.1 through M-327.1.3.

M-327.1.1 For installation on roofs, see Section M-306.0 and Article 6.

M-327.1.2 Water overflow openings and lines shall be not less than the size of the discharge outlet of the appliance. Lines shall be of approved galvanized steel, copper or plastic and shall be pitched to drain into a trapped and vented plumbing fixture with a minimum required air gap of at least one (1) inch.

M-327.1.3 Wiring for evaporative coolers shall meet the requirements of the electrical code of this jurisdiction.

M-327.2 Pads: Evaporative cooling pads shall be of an approved material.

M-327.3 Ducts: In addition to the requirements of this section, ducts shall conform to Table M-301.4 or the duct construction standards listed in Appendix B.

M-327.4 Fire dampers: See Section M-301.11.

M-327.5 Air passage: Air passing through an evaporative cooler shall not pass through the heat exchanger of a furnace.

ARTICLE 4

STEAM AND HOT WATER HEATING SYSTEMS AND PROCESS PIPING

SECTION M-400.0 GENERAL

M-400.1 Scope: The provisions of this article shall govern the construction, installation, alteration and repair of all steam and water heating installations for heating, cooling and certain process piping for all steam and hot water systems unless otherwise provided for in this code.

M-400.2 Equipment: All equipment used for steam or water heating systems and related process piping shall be constructed, installed and maintained in accordance with this article and the applicable standards listed in Appendix B and shall be approved by the building official.

M-400.3 Use of intended fuel: Mechanical appliances shall not be converted from the fuel intended for use to a different fuel, except when converted in accordance with the manufacturer's instructions and approved by the department.

M-400.4 Installation: The installation of systems governed by this article shall conform to the manufacturer's instructions in addition to the requirements of this code. The contractor shall attach operating instructions of a permanent type to the appliance or system. The manufacturer's rating data and the name plate shall be attached to the appliance or system.

M-400.5 Access: Irrespective of other provisions of this code, clearances shall be maintained around all boilers, generators, heaters, tanks and all other equipment so as to permit inspection, servicing, repair or replacement and normal visibility of all gauges.

M-400.6 Boiler room: Every boiler room shall be separated in accordance with the requirements of this code and the building code (see Section M-423.0 and Article 3).

M-400.7 High pressure steam and hot water heating systems: All pipe, fittings, valves, traps, pumps or other equipment to be installed on high pressure installations shall be fabricated of approved materials suitable for the pressures and temperatures intended.

M-400.8 Materials: All materials shall be of an approved type and shall be designated for the pressure and temperatures at which they are to be operated, for the materials they are to handle and for their intended use and shall meet established technical standards of quality and strength necessary to produce safe installations and conform to the standards listed in Appendix C.

M-400.9 Valves on boilers: In high pressure systems, all high temperature generating equipment shall have suitable type shut-off valves installed as close to the outlets of the equipment as possible, both on flow and return piping. Such valves shall be of the material suitable to the service, pressures and temperatures of the systems.

M-400.10 Generators and pressure vessels: Steam boilers and generators operating at pressures in excess of one hundred (100) psig (pounds per square inch gauge) shall, in addition to the required hand shut-off valve, be provided with an approved type automatic shut-off valve. Such valve shall be capable, under test, of stopping all flow of steam from the boiler or generator to prevent excessive drop in pressure resulting from pipe or equipment failure (see Appendix B).

M-400.11 Installation or repairs affecting building structure: When installation or repair of any system regulated by this article affects the building structure, proper structural elements or other supports shall be installed conforming to the requirements of the building code.

M-400.12 Temporary heating during construction: All heating equipment used during construction, other than approved portable units, shall be wired and operated so that all controls function in a normal manner.

M-400.13 Prohibited installations: Gas, liquid or solid fuel-burning appliances shall not be installed in garages unless otherwise permitted by other portions of this code. The installation of piping shall not be permitted in the shafts, pits or penthouses of elevators. Used equipment shall not be installed prior to approval by the building official. Cast iron boilers and cast iron radiation shall not be permitted in steam or water heating systems operating at pressures in excess of fifteen (15) psig for steam and thirty (30) psig for water, unless such boilers or radiation are designed and tested for higher working pressures and listed by a nationally recognized testing or inspection agency.

SECTION M-401.0 BOILERS OR GENERATORS (STEAM AND HOT WATER)

M-401.1 General: All boilers or generators used to generate heat in the form of steam or hot water shall be erected, assembled or installed in accordance with the manufacturer's recommendations and the requirements of this code.

M-401.2 Foundations

M-401.2.1 All boilers or generators shall be set or erected on a masonry or concrete foundation or other approved foundation or support capable of properly supporting the weight of the boiler or generator under full operating load.

M-401.2.2 Brick foundations for boilers or generators may be acceptable if the construction is of hard-pressed brick and cement mortar designed to support the imposed loads. If the brick foundation forms part of the combustion chamber or is exposed to extreme heat, proper provision shall be made for the expansion and insulation of the brick work.

M-401.2.3 Boilers, generators or other equipment shall not be installed unless proper provision to support or carry the additional equipment-loaded weight has been incorporated in the design of the building structure.

M-401.3 Access: Adequate space shall be provided in all boiler rooms for the erection or installation of the boiler or boilers and the equipment to be used. All equipment shall be accessible for service and repairs.

M-401.4 Venting: See Article 7.

SECTION M-402.0 HEADERS AND CONNECTIONS ON STEAM BOILERS

M-402.1 Steam headers: Steam outlets or openings in all cast iron section type steam boilers shall be connected into a common steam header. The size of such header for boilers having not more than two (2) steam outlets shall be not less in nominal diameter than the nominal diameter of the larger of such outlets. The size of such header for boilers having more than two (2) steam openings shall be increased one (1) pipe size for each additional two (2) steam outlets. Reducing the size of the openings between boiler and header is prohibited. All steam headers shall be installed so as to permit expansion of the boiler. Rigid-type headers having the steam openings connected without the use of any fittings are prohibited. Offset headers shall be placed or installed to the right or left side of the steam openings of the boiler by use of ninety (90) degree fittings. The riser pipes from the steam openings shall be connected into the horizontal header by the use of elbows and flanges placed either in the riser pipe or in the horizontal pipe running from the riser to the header. The final connections to the header may be made by welding or with screw-type fittings.

M-402.1.2 Return headers: Return openings in all cast iron section type steam boilers shall be connected into a common return header. The size of the return header shall be not less in area than one-half (½) the area of the steam header. Total cross-sectional area of connections from return openings to header shall be equal to the cross-sectional area of the return header. Where more than two (2) return openings are provided on a boiler, the openings selected to connect into the return header shall be those at either end of the boiler so that complete circulation through the boiler may be attained. If the return opening or openings selected on the boiler are larger in area than is required for a return header, such opening or openings may be reduced so that the total area will not be less than the area required for a return header. Where return openings of boilers are reduced, eccentric bushings or eccentric fittings shall be used. Where return headers connect to boiler return openings, the use of ells is prohibited. Tees shall be used and so installed that one (1) opening of the tee is in line with the opening of the boiler. This opening shall be capped-off full size.

M-402.2 Steel boilers: A header is not required for fire-box type steam generators or other types having only one (1) steam opening and one (1) return opening. Piping connections shall be offset to provide for expansion. A Hartford Loop and Tee connection shall be installed.

SECTION M-403.0 BOILERS IN PARALLEL BATTERIES

M-403.1 General: Where boilers are installed in batteries of two (2) or more, with cross-connected steam and return headers, such boilers shall be installed so that the operating water line or level of all boilers to be operated as a unit will be at the same level.

M-403.2 Sectional-type boilers: All sectional-type boilers used in series or in batteries with other sectional-type boilers shall have separate headers for steam and return connections as provided for individual boilers. Each boiler shall have valves on the supply and return piping so that is may be shut off from other boilers operating in same battery without interfering or affecting operation of the other boilers. The steam supply to the common header or main steam supply piping shall be taken from the individual header of each boiler. The return to each boiler shall connect to a common header that in turn is connected to each boiler return header. On steam boilers, the steam outlet may be connected directly to main steam header on main steam supply, but an equalizing pipe and Hartford connection shall be installed on gravity return systems where the boiler is used for low pressure service. Boilers shall also be valved so they can operate as individual units.

SECTION M-404.0 HARTFORD TEE AND EQUALIZING PIPE REQUIREMENTS

M-404.1 General: An equalizing pipe shall be connected between the steam header and the return header. The size of such pipe shall be the same as the steam header to a point not less than six (6) inches below the water line of the boiler. Reduction may be made at this point to the same size as the return header or piping. A tee or welded connection shall be installed in the equalizing pipe, prior to reduction in size, and located at a point two (2) inches below water line measured from the top of the side opening of the tee or top of the side weld connection. The use of "Y" lateral type fittings or weld are also permitted in place of straight type tees. When "Y" fittings are used, the branch or side outlet of "Y" shall be installed to run down, or installed in an inverted position. If threaded tee is used, a close nipple shall be used between tee and an elbow, and such ell shall point downward. From the inverted "Y" or the elbow, a pipe shall run downward and parallel to the equalizing pipe to a point near the floor line. All direct return piping from the system shall be connected to this pipe, and the size of such pipe shall be not less in internal cross-sectional area than the connected return piping.

M-404.2 Return or vacuum pumps

M-404.2.1 Where boiler return pumps or vacuum pumps are used as a means of returning condensate to the boiler instead of gravity return, the size of the pipe connecting to a Hartford connection shall be one (1) size larger than the outlet or discharge connection of the pump. If the distance between the pump and the boiler is over thirty (30) feet, the size of the pipe shall be increased to compensate for increased pressure loss. Check valves shall be installed in this pipe between the pump and the boiler.

M-404.2.2 Where boiler return pumps or combination return and vacuum pumps are used to return condensate to the boiler, they may be connected through a Hartford Tee and Loop connection or directly to boiler return piping. Pipe from pump to boiler shall be run up in a vertical position from pump to height not less than three (3) feet above the water line of the boiler, or to ceiling if ceiling is less than three (3) feet, carried across to the boiler at that height, then dropped to below water line of the boiler and connected to a Hartford Tee or direct to boiler return piping with necessary check valves installed.

SECTION M-405.0 SAFETY OR RELIEF VALVES AND REDUCING VALVES

M-405.1 General: All steam boilers, hot water boilers and generators, or any type of pressure vessel used for steam generation, for processing or for building heating systems and tanks, and other equipment used for the purpose of generating or storing hot water under pressure, shall be equipped with a side outlet type and approved ASME-NB pressure-safety or relief valve(s), approved for the type of equipment on which it is installed, and for the temperatures, pressures and fluids with which it is to operate (for the purposes of this article ASME-NB shall mean American Society of Mechanical Engineers-National Board). Such valves shall be rated as maximum unit capacity or not less than the burner output capacity. The requirements for temperature-relief valves shall be the same as those required for pressure-relief valves, except that temperature-relief valves shall be of an approved type and need not bear the seal of the ASME-NB. Approved combination-type pressure and temperature relief valves may be permitted on tanks up to one hundred (100) gallon storage capacity; however, tanks in excess of one hundred (100) gallon storage capacity shall be equipped with separated valves for relief of temperature and pressure.

M-405.1.1 When the horsepower of a steam boiler or generator is in excess of five hundred (500) horsepower, a second approved relief valve of adequate size to handle the boiler output shall be installed. Such valve shall be permanently marked showing pressure and capacity rating.

M-405.1.2 Valves on hot water boilers and generators and hot water pressure vessels or building heating systems shall be of the type designed for hot water use and bear the ASME-NB permanent rating label indicating the capacity of the valve in Btus and the pressure at which it is to operate. When the equipment has a heat input rating in excess of fifteen million (15,000,000) Btus, a second relief valve of adequate size to handle the boiler output shall be installed. Temperature-relief valves shall be permanently marked indicating temperature relief rating. Pressure-relief rating is not to be in excess of thirty (30) psig for cast iron boilers regardless of weight of water in the system, and a pressure-relief rating is not to be in excess of forty-five (45) psig for steel boilers, regardless of weight of water in the system.

M-405.1.3 Required side outlet type relief valves shall be installed on top of boilers and at the heat exchanger. Stops, valves or other obstructions that will prevent the full pressure of the heating system from being applied to the relief valves at all times are prohibited.

M-405.2 Location: All relief valves shall be installed in openings by the manufacturer of the equipment. If such openings are not provided, the valves shall be installed in the piping of the equipment as close to the equipment as possible. Pressure-relief valves shall be installed in the cold water supply piping as close to the heater or tank as practicable, so the valve will be under the same constant water pressure as the equipment. Valves or stop cocks shall not be permitted between boiler or pressure vessel and pressure valves, except on boilers in excess of one thousand (1,000) horsepower and having two (2) or more relief valves. Reduction in the size of the relief valve connections shall not be permitted.

M-405.3 Test lever: All relief valves shall be provided with a suitable type hand test lever.

M-405.4 Valve setting: All valves shall be tested after installation to indicate that they relieve at the pressure or temperature set and designated on the valve. Any valve failing to open within ten (10) per cent of the setting marked shall be considered defective and shall be replaced.

M-405.5 Valve seals

M-405.5.1 The seal provided by the manufacturer of the relief valve to seal valves at designated pressure or temperature shall not be broken without special permission of the building official. If permission is given to change or reset the valve, such valve shall be resealed in the presence of an authorized representative of the department and permanently tagged and marked to indicate the new setting permitted.

M-405.5.2 Where the seal on any type of relief valve is found broken without permission of the building official, the equipment on which the valve is installed shall be ordered out of service until a new valve of proper size and type has been installed on the equipment, and such new valve is tagged and sealed in an approved manner.

> **Exception:** If, however, the equipment cannot be ordered out of service, the relief valve shall be immediately checked. If found to be operating properly, the valve shall be resealed and tagged in an approved manner.

M-405.6 Discharge: Safety or relief valve discharge openings shall be piped the full size of the relief opening to a location where the discharge cannot be injurious to the plant, the building or to personnel. If the discharge pipe from the relief valve is piped to the outside of the building, provisions shall be made to secure proper drainage and prevent freeze-up. Discharge pipe from the relief valve, piped to the inside of the building, shall be piped to within six (6) inches of the boiler room floor or to an approved plumbing receptacle. The boiler room floor shall be provided with a drain or an approved plumbing receptacle connected to the sewer, and the drain pipe from such device shall not be less than one (1) nominal iron pipe size larger than the drain outlet of the relief valve. The discharge end of the pipe from any relief valve shall be open to the atmosphere so as to provide a minimum air gap between the overflow rim to the receptacle of the sewer opening or floor drain of twice the inside pipe diameter of the relief valve discharge pipe.

M-405.7 Pressure valves

M-405.7.1 On all closed building heating systems, in addition to the compression tank, an approved type of pressure-reducing valve and pressure-relief valve shall be installed. The reducing valve shall be capable of reducing the water supply pressure to the safe operating requirements of the heating system. This valve shall be of not less than one-half (½) inch nominal iron pipe size and shall be installed in the makeup water supply line. Combination pressure-reducing and relief valves are prohibited.

M-405.7.2 An approved pressure-relief valve shall be installed on all closed heating systems. The capacity and size of the relief valve shall be in accord with the Btu-generating capacity of the heat exchanger or boiler. Relief valves less than one-half (½) inch pipe size shall not be installed in any closed hot water system. On large systems, where the Btu capacity of the system is greater than the capacity of any one (1) relief valve to provide adequate protection, two (2) or more valves shall be provided to meet the Btu-generating capacity.

SECTION M-406.0 WATER LEVEL AND STEAM PRESSURE GAUGES AND TRY-COCKS

M-406.1 General: Each low pressure steam boiler shall be equipped with the following:

1. a water level gauge glass mounted so that the mid-point of the glass is at the normal water level of the boiler;
2. at least two (2) hand operated try-cocks mounted one and one-half (1½) inches above and one and one-half (1½) inches below the normal water level of the boiler; and
3. a steam pressure gauge mounted on or at the top of the boiler.

M-406.2 Gauge glass and try-cocks: The gauge glass and try-cocks may be mounted directly on the boiler, independent of all other connections. If the boiler is equipped with a separate water column on which the gauge glass and try-cocks are installed, and this water column is connected to the boiler by means of pipe and fittings, the bottom of the water column shall be provided with a blow down valve of the gate valve type and at least the size of the piping connection of the water column. Wherever separate water columns are to be connected to boilers, the water columns shall be piped to the boiler using plugged crosses for all ninety (90) degree bends in such piping.

M-406.3 Steam gauge: The steam gauge shall be clearly visible from the operating floor or normal access area at all times. It shall be the low pressure type with easily read numerals, at least four and one-half (4½) inches in diameter and with a maximum rating of one and one-half (1½) times the maximum operating pressure of the boiler. Such gauge may be mounted directly on the boiler or at the top of the water column and shall have a syphon loop between the gauge and the boiler connection.

SECTION M-407.0 BLOW-OFF VALVES

M-407.1 General: Each steam boiler shall be provided with a proper size blow-off or drain valve or valves of the quick opening or one-fourth (¼) turn type. Such blow-off or drain valves shall be installed in the opening of the boiler provided by the manufacturer or in the return header at the boiler and shall be so installed that the boiler will be completely drained. The blow-off or drain valve shall be at least three-fourths (¾) inch size for boilers of up to one thousand (1,000) square feet of radiation capacity, one (1) inch for boilers up to three thousand (3,000) square feet of radiation capacity, one and one-fourth (1¼) inches for boilers up to eight thousand (8,000) square feet of radiation capacity and one and one-half (1½) inches for boilers in excess of eight thousand

(8,000) square feet of radiation capacity. The blow-off or drain valve shall not be connected directly to any sanitary sewer system. When drained to a sewer, it shall drain to an open floor drain, approved receptor or to a regular blow-off tank or sump. The temperature of the discharge water shall not exceed one hundred eighty (180) degrees F. when it enters the sanitary sewer system. The blow-off or drain may discharge into an approved leaching pit.

M-407.2 Blow-off and sump tanks

M-407.2.1 Blow-off or sump tanks shall be installed where either are necessary to properly blow down or drain the boiler, or where the boiler is set or pitted below the level of the boiler room or below the low point of any floor drain connected to the sewer.

M-407.2.2 Where sump or blow-off tanks are installed below the level of sewer piping, an automatically controlled, power-driven pump shall be provided to raise the water for proper drainage into the sewer.

M-407.2.3 All piping between blow-off and drain valves and connecting to sump or flush tank shall be connected directly to the tank and shall not be less than the size piping of the blow-off or drain valve. Such pipe and fittings shall be capable of withstanding the full pressure of the boiler.

SECTION M-408.0 LOW WATER CUT-OFF CONTROLS, WATER FEEDERS

M-408.1 General: An external low water cut-off control shall be installed on all fuel-fired steam boilers or generators in such a manner so that the fuel-firing device will shut off when the level of the water is within one (1) inch of the bottom of the gauge glass. The use of internal type low water cut-off valves is prohibited.

M-408.1.1 A water feeder may be installed to operate and maintain the water at the proper operating level in steam boilers. A water feeder shall not be equipped with a low water cut-off control. Combination feeders and low water cut-offs are permitted.

M-408.1.2 The quick hook-up type of low water cut-off or combination feeder and cut-off that are attached or connected to the gauge glass connections of a steam boiler are permitted on steam boilers not in excess of two thousand (2,000) square feet of radiation capacity or the equivalent in boiler horsepower. All boilers larger in size shall use the type of low water cut-off or feeder combination that is attached directly to the boiler by means of separate pipe connection, one above the water line of the boiler, the other at least twelve (12) inches below the normal operating water line of the boiler. The connecting pipe to the boiler shall be not less than on (1) inch iron pipe size. Such pipe shall have a blow-off valve installed at the lower connection.

M-408.1.3 Each type of low water control and combination-type feeder and control shall be equipped with a flushing valve, gate valve or quick-opening valve. This valve shall be the full size of the opening provided at the bottom of the control. Flushing valves shall be provided with permanently marked tags carrying instructions to the operator to flush the low water control at least once a week.

M-408.2 Special types: Special types of low water cut-offs and water feeders that are supplied by the manufacturers of boilers as part of the boiler equipment or built into the boiler are acceptable when approved by the building official.

SECTION M-409.0 PIPING FOR STEAM AND HOT WATER HEATING SYSTEMS

M-409.1 General: All steel and wrought iron pipe shall be at least Schedule 40 pipe, or pipe or tubing of equivalent working pressure and tensile strength. Brass or copper pipe, and copper or steel tubing may be used on hot water heating installations if the system is designed to operate within such pipe or tubing working pressure rating.

M-409.2 Reaming: All pipe or tubing shall be reamed after cutting to not less than full internal dimensions.

M-409.3 Pipe joining: Steel or wrought iron piping may be joined by welding or by the use of screw or flanged fittings. Copper or tinned steel tubing may be joined by blazing, soldering or approved compression fittings.

M-409.4 Pipe support: Pipe and piping shall be properly hung and supported to permit expansion and contraction. "U" bends, swing joints or expansion joints shall be installed so as to permit free expansion and contraction of the piping. Swing joints or "U" bends shall be fabricated of equivalent pipe material and shall be suitable for the pressures and temperatures at which the installation is designed to operate. Expansion joints of either the slip sleeve or corrugated copper type may be used where such joints meet the temperature and pressure requirements of the installation.

M-409.4.1 All piping shall be securely supported on substantial non-combustible supports or hangers. The hangers or supports shall be securely fastened to an adequate support or structural member, and the hangers or supports shall be so spaced that there shall not be undue stress or strain on the pipe, joints, fittings or valves so that sagging will not occur in the pipe between points of suspension under normal operating conditions.

M-409.4.2 The piping shall be securely fastened to proper type anchor foundations where necessary to prevent undue stress or strain on boilers or equipment due to weight of the pipe or expansion and contraction.

M-409.5 Piping through walls, floors, etc.: Piping passing through walls, ceilings, floors, beams, or any portion of the building structure shall be free to expand and contract and shall not be embedded in plaster, concrete or masonry. Such piping shall be provided with metal sleeves or thimbles when passing through concrete or masonry walls, ceilings, floors or beams, and such sleeves or thimbles shall be at least three-eighths (⅜) inch larger than the outside diameter of the pipe plus the insulation. Openings through wooden floors, ceilings, walls and beams shall be at least three-eighths (⅜) inch larger than the outside diameter of the pipe or the pipe plus insulation. When copper tubing is installed in a concrete slab or in the earth below a slab, it shall be installed in a sleeve with a diameter not less than three-fourths (¾) inch greater than the outside diameter of the tubing; the tubing shall be arranged to permit expansion and contraction without damage to the tubing or to the building structure, and all joints shall be made with solders or copper brazing rods having a minimum melting point of one thousand (1,000) degrees F. Where steel pipe is installed in a concrete slab or in the earth below a slab, it shall be installed in a casing or conduit, and such steel pipe shall be protected against corrosion. The casing or conduit shall be laid in a straight line and shall extend into accessible portions of the building to permit the removal or insertion of the pipe when the casing or conduit is in place. Corrosion protection shall consist of a thick coating of bituminous material, applied in molten condition, with a wrapping of asbestos fabric saturated with bitumens. Mill-wrapped pipe shall be acceptable if all joints are protected in substantially the same manner as the original pipe. The building official shall approve the type of sleeve and insulation to be used on piping carrying steam, water, or other fluids at temperatures in excess of three hundred (300) degrees F (see Section M-417.0 for radiant heatings systems).

M-409.6 Vertical piping secured: Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents but not less than at every other story height.

M-409.7 Branch main stress: Where the main stream supply or hot water supply piping or the main return piping of a system is divided into two (2) or more branch mains or returns, such branches from the main piping shall be taken off with tees and elbows or "Y" branch fittings, so installed and connected that undue stresses or strains from pipe expansion or other causes shall not be placed on the pipe fittings or threads at the point or points of junction of the piping.

M-409.8 Bull-heading tee: The use of bull-heading tee connections is prohibited where the side opening of a tee is connected to the main piping and where two (2) branch connections are taken off of the run of the tee, thereby forming a rigid connection.

M-409.9 Welding: Where welding is used as a means of connecting or joining branch mains to the main steam piping, provisions shall be made for the expansion of the pipe at this point so that undue stresses or strains shall not be placed on the welds or piping. The bull-heading or rigid tee is prohibited on this type of connection.

M-409.10 Connections from mains, branch mains or return piping: All connections from the mains, branch mains or return piping of a steam system to radiators or to supply risers running to upper floors of a building shall be taken off at the top of the supply or return piping by use of a forty-five (45) degree or ninety (90) degree elbow, where fittings are used or welded into the top of the piping, where the welded method of connection is used.

M-409.11 Cold water supply to hot water tank: The cold water supply to a hot water tank used for processing shall be discharged within three (3) inches of the bottom of the tank either by direct connection at this point or by means of a pipe or tube inside of the tank. There shall be installed, on the cold water line close to the tank, a hand shut-off valve and a check valve. The check valve shall be installed to prevent hot water flow back from the tank into the cold water supply piping.

M-409.12 Approved materials

M-409.12.1 All threads on pipe, valves, flanges, and similar fittings shall conform to American Standard Taper Pipe Threads.

M-409.12.2 Required gaskets shall be made of material approved for the pressure and temperature to which they are to be subjected. Rubber shall not be used where pressures exceed fifteen (15) psig steam and forty-five (45) psig water or where temperatures are greater than two hundred fifty (250) degrees F.

M-409.12.3 Threaded joints shall be made up with an approved thread compound or lubricant.

M-409.12.4 Screw-type flanges of cast iron, steel or forged integral type may be used up to their working pressure and temperature ratings. All companion flanges shall have matching facing and drilling.

M-409.12.5 All pipe fittings and valves used on high pressure installation shall be of the type designed for the pressures and temperatures of the installation.

M-409.12.6 All pipe and piping used on high pressure-high temperature installations shall be of the required weight and strength suitable for the type service and pressure intended. Stress relieving may be required by the department for high pressure-high temperature welded installations.

SECTION M-410.0 PITCH OF PIPING

M-410.1 General: All piping shall be properly pitched or graded for proper venting. Wherever practical, the water pipe shall be so pitched that the air or gases flowing to a high point or vent point will flow in the same direction as the water.

M-410.2 Steam mains: All steam mains shall be pitched or graded in the direction of the flow of steam from the boiler. The grade or pitch shall be at least one (1) inch per each twenty (20) feet of horizontal pipe run. The high point shall be established at or near the boiler. The pitch or grades shall be carried to the end or ends of the steam mains. The ends of the steam mains shall be properly dripped and connected into the return piping of the system so that the condensate will be carried back to the boiler directly or to a boiler return pump or return trap.

M-410.3 Branches

M-410.3.1 All branches to radiators or to supply risers on steam heating systems shall pitch up from the point of connection to a main or return piping at least one (1) inch per each four (4) feet of horizontal run. If the horizontal run from the main to the radiator or riser on the steam system is over eight (8) feet in length, such run shall be increased one (1) pipe size.

M-410.3.2 If the building or structural conditions are such that the branches cannot be pitched up from the connection point and must be pitched down to the point where they rise to connect into the radiator or riser, the branch shall be dripped to a steam trap at the low point and trap connected to the return piping.

M-410.4 Grading

M-410.4.1 Where structural conditions make it necessary to regrade or elevate the steam main or mains, or where the difference in the floor or ceiling heights or levels requires that the pipe be regraded, and where the change in grade or level causes the formation of pockets in which condensate can collect and cut down the capacity of the piping, a drip pocket and steam trap shall be installed at the low point and connected to the return piping. The size of the drip connection trap and trap connection shall be adequate to drain the amount of condensate anticipated, but the drip connection shall not be less than three-fourths (¾) inch iron pipe size.

M-410.4.2 Where structural conditions of the building are such that the steam main cannot be pitched so that the steam and condensate will flow in the same direction, and it becomes necessary to pitch the main piping up so that it is necessary for the condensate to flow back against the flow of steam, the size of the pipe main shall be increased and properly dripped.

M-410.4.3 Runouts: Steam lines having runouts shall be sized so that the pressure drop does not exceed twenty-five hundredths (0.25) psig per one hundred (100) feet of length in order that the critical steam velocity will not be exceeded.

SECTION M-411.0 EXPANSION TANKS

M-411.1 General: An expansion- or compression-type tank shall be installed and used on all hot water heating systems. The size of such tank shall be determined from the gallons of water contained in the system or from the square feet of radiation capacity of the system. Heating systems using convectors, baseboard radiation or radiant coils in floors, walls or ceilings shall have the tank capacity rated for the number of gallons of water in the system. The capacity of tanks sized by the gallons of water in the heating system shall be at least one (1) gallon for each seven (7) gallons of water in the system. The capacity of tanks sized by the square feet of radiation capacity shall be at least one (1) gallon for each fifty (50) square feet of cast iron radiation or its equivalent radiation.

M-411.2 Compression-type expansion tank use on closed systems: This shall be a pressure-type tank and shall be installed as recommended by the manufacturer and as approved. Tanks shall be suitable for the pressure carried in the system and shall be stamped in accordance with the ASME Boiler and Pressure Vessel Code listed in Appendix B (see also Section M-405.0).

M-411.3 Open-type expansion tank: Expansion tanks on open-type gravity system shall be vented to the atmosphere. The type of tank shall be installed at least four (4) feet above the highest radiator or connector installed on the system. A pipe of at least one (1) inch iron pipe size shall connect such tank to the supply or return main of the heating system. Valves or stops shall not be installed in such pipe. Radiator connections shall not be attached to such pipe. Such pipe shall run as directly as possible from the supply or return main to the tank. From the top of such tank, a pipe of one (1) inch iron pipe size or equal shall be carried to the boiler location and installed to within six (6) inches of the floor having a floor drain or over an open approved receptor. Such pipe shall not be connected to any sewer pipe or vent stack and shall not be vented through the roof or wall of the building. Tank and piping shall be protected from freezing.

SECTION M-412.0 LOW-WATER CUT-OFF, HOT WATER HEATING BOILERS

M-412.1 General: All fuel-fired water heating boilers or water heaters, in excess of four hundred thousand (400,000) Btu input, shall be provided with an externally mounted low water cut-off or control. The use of internal-type low water cut-off is prohibited.

M-412.2 Electrical: The low water cut-off shall be installed in accordance with the manufacturer's instructions and wired into the electrical supply circuit controlling the firing device so that the fuel supply will be shut off when the water drops to the level at which the control is set to operate.

SECTION M-413.0 WATER SUPPLY CONNECTIONS

M-413.1 **General:** All hot water heating systems, boiler, generators or pressure vessels shall be provided with a permanent makeup or feed water connection to such equipment from the water supply. Such water supply piping shall be of the proper size to furnish water to the equipment but shall be not less than one-half (½) inch iron pipe size. A hand operated compression, globe or gate type valve shall be installed on this line.

M-413.2 **Water supply:** The water supply connections shall be connected to the piping of the heating system.

M-413.3 **Check valve:** A check valve of the same size as the water supply piping to the boiler shall be installed in the feed water line so that water from the heating system cannot flow into the building supply line. Where pressure-reducing feed valves are installed that have check valves incorporated, a separate check valve shall not be required.

M-413.4 **Power driven feed water pump:** A power driven feed water pump, capable of building up the required pressure to furnish feed water to the equipment while operating under full load conditions, shall be installed on all installations where the pressure of the equipment is in excess of the water supply pressure. A feed water injector may be installed in lieu of a feed water pump on boilers rated at five (5) horsepower or less.

SECTION M-414.0 GAUGES AND THERMOMETERS

M-414.1 **General:** All automatically-fired water heating boilers or systems used for heating buildings or structures shall be provided with a low water cut-off or control.

M-414.1.1 Altitude or pressure gauge or a combination of both shall be installed on all hot water heating systems. The gauge shall be installed in the outlet of the boiler or heat exchanger or as near as possible, so that it will register true pressure of the boiler at all times.

M-414.1.2 A standard type hot water thermometer shall also be installed on all hot water boilers or heat exchangers and shall be so located as to indicate the true temperature of the water.

M-414.1.3 Approved combination gauges that indicate altitude, pressure and temperature of water in systems may be installed.

SECTION M-415.0 HEATING WITH STEAM FROM UTILITY CENTRAL STEAM HEATING SYSTEM OR OTHER TYPES OF STEAM DISTRIBUTING SYSTEMS

M-415.1 **General:** Steam supply piping from any central heating system entering into an individual building shall be provided with a steam shut-off valve of the same size as the supply pipe to the building; the valve shall be installed near the junction of the pipe and the building basement or boiler room. Connections to the steam supply of building piping shall be made on the building or load side of such valve.

M-415.2 Reducing valve required

M-415.2.1 Where the steam pressure supplied from such systems is of greater pressure than the design pressure of the heating equipment or other equipment used in the building, an approved pressure-reducing valve shall be installed to regulate the steam pressure to such equipment.

M-415.2.2 A shut-off valve shall be installed on both sides of pressure-reducing valves used to reduce the steam pressure to the operating pressure permissible in the building. If a by-pass line is installed around the pressure-reducing valve, such by-pass shall be at least one-half (½) the size of the reducing valve and shall be controlled by a globe-type stop valve of the same size as the by-pass line.

M-415.2.3 Where reducing valves are installed, a shut-off valve shall be installed on both sides of the reducing valve. The by-pass line shall be connected so that when the shut-off valves are closed, steam can be by-passed.

M-415.2.4 On the downstream side or low pressure side of the reducing valve, a steam gauge and low pressure-relief or safety valve shall be installed and shall be set at maximum pressure at which the low pressure heating system is designed to be operated. Such relief or safety valve shall be installed in compliance with Section M-405.0.

M-415.2.5 Reducing valve shall be of the normally closed operating type with positive shut-off in the event of a control air pressure failure, and a spring-loaded reducing valve of normally open type shall be installed on the by-pass steam line to open in the event of a control air failure.

M-415.3 Return condensate: The return condensate from a building heated by a central steam supply may be discharged either into a return condensate system or wasted into a sewer drain connection or approved leaching well. This condensate when discharging into a sanitary sewer system shall not be in excess of one hundred eighty (180) degrees F. and shall discharge into an open floor drain or a special drain connection or approved receptor. If the floor drain or drain connection to the sewer is above the level of the return piping so that it cannot flow by gravity, an automatic sump pump shall be installed to pump the condensate from the sump to the sewer drain.

SECTION M-416.0 GAS, OIL AND SOLID FUEL BURNERS

M-416.1 General: All burners shall be in compliance with Article 6.

SECTION M-417.0 RADIANT HEATING SYSTEMS

M-417.1 General: The installation of all types of radiant heating systems where the source of heat is obtained from heated pipes or tubing embedded in the walls, floors or ceilings of the structure to be heated shall be designed or installed in strict accordance with the approved standard methods for the design and installation of such systems and this code.

M-417.2 Approved piping: All pipe used shall be standard weight iron or steel pipe, copper tubing, or other approved types of materials suitable for the type of installation and design.

M-417.3 Piping embedded: Where pipes or tubing forming a radiant heating panel are embedded in the structure of the building, all steel and iron pipe shall be joined together by welding with the electric arc or oxygen-acetylene method, and all copper tubing shall be joined together with solders or copper brazing rods having a minimum melting point of one thousand (1,000) degrees F. The use of screw fittings, compression fittings, flare fittings or other means of joining the pipes or tubing together shall not be permitted.

M-417.4 Piping exposed: Where piping of a radiant heating system is exposed and accessible, as in a boiler room or basement, the use of fittings, unions and other standard methods of connecting the piping together and making necessary connections to the boiler or pumps, compression tank, relief valves and water supply piping are permitted.

M-417.5 Testing: All piping or copper tubing installed as a portion of a radiant heating system that will be embedded in the walls, floors, or ceilings of the building it is designed to heat shall be thoroughly tested for leaks by the hydrostatic test method by applying a pressure of not less than one hundred (100) psi water pressure or one and one-half (1½) times the operating pressure, whichever is the greater. A pressure gauge shall be connected to the piping and, after the pressure has been raised, the hydrostatic pressure connection shall be discontinued, and the systems under pressure shall remain at the test pressure for a sufficient period of time to determine whether any leaks exist in the system. Leaks shall be indicated by the pressure drop on the gauge. Minimum test period shall be four (4) consecutive hours. All tests for tightness on radiant piping systems shall be approved by the building official.

SECTION M-418.0 CHIMNEYS, FLUES, VENTS AND COMBUSTION AIR

M-418.1 General: All chimneys, flues, vents and combustion air shall meet the requirements of Articles 6 and 7.

SECTION M-419.0 BLOW-OFF TANKS

M-419.1 General: Blow-off tanks constructed of steel shall be designed and fabricated in accordance with recognized and accepted methods of construction.

M-419.1.1 For boilers carrying one hundred (100) psi steam pressure or less, the tank heads and shell shall be constructed of not less than one-fourth (¼) inch steel.

M-419.1.2 For boilers carrying in excess of one hundred (100) psi pressure, tanks shall be fabricated of material designed for the pressures carried.

M-419.1.3 Blow-off tanks shall be stamped in accordance with the ASME Boiler and Pressure Vessel Code listed in Appendix B.

M-419.2 Size: The size of the tank shall be indicated by the blow down requirements, and the tank installed shall be large enough to blow down one (1) gauge glass of water from one (1) boiler or from any one (1) of a battery of boilers interconnected.

M-419.2.1 The size of the tank shall be of sufficient capacity so the blow down water from the boiler will only fill one-half (½) the capacity of the tank, and the remaining area of the tank shall be available for the vapor displacement.

M-419.3 Discharge: The discharge from the boiler or boilers shall enter the tank above the high water level or surface of the water in such tank. A baffle plate shall be installed in the tank in line with the inlet pipe from the boiler and shall be at least twelve (12) inches from the discharge opening from the boiler into the tank. The outlet opening or discharge from the tank shall be at least two (2) times the area of the inlet pipe, and such outlet pipe shall have an internal pipe built into the tank, extending downward to within four (4) inches of the bottom of the tank. The discharge pipe shall be connected to a sewer through a running trap or to an approved leaching well.

M-419.4 Venting

M-419.4.1 All blow-off tanks shall be properly vented to the outside atmosphere. Such vent pipes shall be at least four (4) times the area of the inlet pipe from the boiler, and such pipe shall not be less than two (2) inch iron pipe size.

M-419.4.2 The vent pipe shall be run as directly as possible to the outside atmosphere and in a suitable location so that any steam or water discharged by the blow down of the boiler would not be dangerous or injurious to life.

M-419.4.3 The vent shall be free of any pockets or sags that might collect or hold water or cause an obstruction of the pipe and built-up pressure in the tank. The end of the vent pipe shall be protected from the possibility of any obstruction.

M-419.5 Manhole: Each blow down tank shall be provided with a suitable size manhole for the inspection and cleaning of the tank.

SECTION M-420.0 HOT WATER STORAGE TANKS, HOT WATER HEATERS, TANKLESS TYPE WATER HEATERS AND EQUIPMENT: CONSTRUCTION AND MOVING

M-420.1 General: All hot water storage tanks with a capacity of one hundred and twenty (120) gallons or more and tankless heaters with a capacity of two hundred (200) gallons per hour or more shall be installed in compliance with this code. Such tanks used for storage of hot water at municipal water pressure shall be constructed of metal and have a working pressure rating of at least one hundred fifty (150) psig.

> **Exception:** Tanks with a working pressure rating of one hundred (100) psig may be used, provided an approved type of pressure-reducing valve is installed in the supply piping to the tank to maintain the pressure at or below one hundred (100) psig, and the tank is equipped with a pressure-relief valve equal in size to either the supply or discharge line, whichever is the larger.

M-420.2 Approved tanks: Tanks shall be approved for use when labeled or stamped in accordance with Sections M-420.2.1 or M-420.2.2.

M-420.2.1 Tanks shall be approved for use when labeled by a nationally recognized testing or inspection agency or when tested and stamped in accordance with the ASME Boiler and Pressure Vessel Code listed in Appendix B.

M-420.2.2 Tanks shall be approved for use when permanently labeled or stamped by the manufacturer that the tanks have been tested to two hundred and thirty-five (235) per cent of the maximum working pressure, but not less than two hundred (200) psig hydraulic or hydrostatic pressure and the maximum working pressure at which it may be installed.

M-420.3 Tankless water heaters: The design working pressure shall be permanently stamped or marked on tankless water heaters.

M-420.4 Indirect heated type water heaters: The design working pressure shall be permanently stamped or marked on indirect heated type water heaters.

M-420.5 Direct heated type water heaters: Direct heated type water heaters shall have permanently stamped or marked on them their design working pressure, and this shall be the maximum permissible working pressure of the tank or heater. If the pressure of the water supply to the heater is in excess of the design working pressure, a reducing valve shall be installed to lower the pressure to the rated working pressure permitted on the heater or tank, whichever is the lesser. Safeguards shall be provided to prevent the water heater from being subjected to pressures in excess of the rated working pressure.

M-420.6 Tank stands

M-420.6.1 All tanks shall be installed on a suitable type stand or concrete foundation capable of supporting the combined weight of the tank and contents.

M-420.6.2 Tank stands shall be constructed of fabricated steel beams or channels welded or bolted together, or steel pipe and malleable iron fittings welded to form adequate support for the tank and contents. When pipe is used for the cross member on which the tank shall rest, such pipe shall be of double strength or extra heavy pipe or two (2) pipes, one inside the other, the inner pipe to be of the next size smaller than the pipe used as the cross pipe or bearings pipe.

M-420.6.3 Tank stands shall be supported directly from floor or tank foundation and not from a partition or building wall unless such wall is designed to carry the additional load. When tanks are installed in the basement, and the floor under tank stand is not capable of supporting the weight of tank and contents, such floors shall be reinforced to be capable of carrying the weight. All stand legs resting on concrete (basement) floor shall be set on either round or square bearing plates not less than one-half (½) inch thick and sized so that stress or load on concrete at its perimeter shall not exceed two hundred (200) pounds per lineal inch of perimeter.

M-420.6.4 Tank installations on other floors of buildings, where the weight must be supported by the building structure, shall be subject to approval by the building official.

SECTION M-421.0 BOILING-OUT PROCEDURE FOR STEAM BOILERS AND GENERATORS

M-421.1 General: All steam boilers or steam generators shall be boiled-out prior to being put into service. The procedures listed below shall be followed.

1. The chemicals shall be completely dissolved in water before being placed in unit.
2. The chemicals may be either pumped into the unit through chemical feed connection or poured through an upper opening or unit. Either of the four (4) compounds of chemicals listed in Table M-421 are acceptable. The concentrations listed apply to all the water in the unit usually at normal operating water level.

SECTION M-422.0 CLEANING PROCEDURE, HOT WATER SYSTEM

M-422.1 General. Hot water systems shall be cleaned according to the

Table M-421
CHEMICALS AND CONCENTRATIONS

Chemical	Concentrations
1. Trisodium phosphate (NA_3PO_4 $12H_2O$)	2500 ppm
Caustic soda ($NaOH$)	2500 ppm
2. Trisodium phosphate (NA_3PO_4 $12H_2O$)	5000 ppm
Caustic soda ($NaOH$)	500 ppm
3. Trisodium phosphate (NA_3PO_4 $12H_2O$)	1500 ppm
Caustic soda ($NaOH$)	1500 ppm
Soda ash (Na_2 CO_3)	1500 ppm
4. Caustic soda ($NaOH$)	3000 ppm
Soda ash (Na_2 CO_3)	3000 ppm

recommendations of the manufacturers of the component water carrying parts and as approved by the building official before such system is placed in service.

SECTION M-423.0 BOILER AND GENERATOR SETTINGS AND CLEARANCES

M-423.1 Mounting

M-423.1.1 Boilers, unless approved for other mounting or setting, shall be mounted on floors, slabs or arches of fireresistive construction with noncombustible flooring and surface finish and combustible material shall be against the underside thereof. Such construction shall extend not less than twelve (12) inches beyond the boiler on all sides, and where solid fuel is used, it shall extend not less than forty-eight (48) inches at the front or sides where ashes are removed.

M-423.1.2 Boilers may be mounted on floors other than as specified in Section M-423.1.1 provided the boiler is such that flame or hot gases do not come in contact with its base, and provided the floor under the appliance is protected with hollow masonry not less than four (4) inches thick covered with sheet metal of thickness not less than twenty-four (24) gauge. Such masonry shall be laid with ends unsealed and joints matched in such a manner as to provide a free circulation of air from side to side through the masonry.

M-423.1.3 Boilers which are arranged so that flame or hot gases come in contact with the base may be mounted on floors other than as specified above, provided the floor under the appliance is protected by two (2) courses of four (4) inch hollow masonry with courses laid at right angles and with ends unsealed and joints matched in a manner to provide a free circulation of air through each masonry course. Top of such masonry base shall be surfaced with a metal plate of thickness not less than twenty (20) gage.

M-423.1.4 All boilers shall be approved by the building official.

M-423.1.5 Boilers of the water-base type may be mounted on floors other than as specified in Section M-423.1.1 provided the water chamber extends under the whole of the ash pit and the firebox, or under the whole of the firing chamber if there is not an ash pit.

M-423.1.6 Steam or hot water unit heaters shall be installed to provide a minimum clearance of one (1) inch.

M-423.2 Clearance to combustible material

M-423.2.1 All steam and hot water heating appliances shall have a clearance to combustible material as specified in this article and Table M-423.2.

Table M-423.2

CLEARANCES TO COMBUSTIBLE MATERIAL FOR BOILERS AND HEAT EXCHANGERS

	Minimum clearance, inches				
	Above boiler	Jacket side and rear	Front (see note [a])	Projecting flue box or draft hood	Chimney connector or vent connector
1. Steam or hot water heat exchanger system not over 15 psi gauge pressure and hot water not over 250° F.	1	1	1	—	—
2. Heating boilers—steam boilers operating at not over 15 psi gauge pressure and hot water boilers operating at not in excess of 250° F. of the water-wall type or having a jacket or lining of masonry or other satisfactory material.					
Burning liquid fuel	6	6	24	18[c]	18[c]
Burning gas fuel	6	6	18	9[b]	9[b]
Burning solid fuel	6	6	48	18	18
3. Boilers, other than above					
Burning liquid fuel	18	18	18	9[b]	9[b]
Burning gas fuel	18	18	18	9[b]	9[b]
Burning solid fuel	18	18	48	18	18

Note a. Front clearance shall be sufficient for serving the burner and boiler.

Note b. This clearance may be reduced to six inches for gas burning boilers that have been tested by a nationally recognized testing or inspection agency and found to have flue gas temperatures not exceeding 550° F. This clearance does not apply to approved Type B gas vents used and installed in accordance with the conditions of such approval.

Note c. For liquid fuel-burning boilers that are approved specifically for installation with lesser clearances, chimney connectors or vent connectors may be installed with the conditions of such approval.

Exceptions: 1. Boilers approved specifically for installation with clearance less than specified in this table shall be installed in accordance with the conditions of such approval. 2. Boilers shall not be installed in confined spaces, such as alcoves or closets, unless equipment has been approved specifically for such installation and is installed in accordance with the conditions of such approval.

M-423.3 Separation of equipment: Direct-fired heating equipment shall be separated from other air handling equipment by a one (1) hour fireresistance rated wall.

Exceptions

1. Combination heating and cooling equipment need not comply to the above if the heating and cooling equipment is an approved single package or tandem unit.
2. One- and two-family dwellings.

M-423.4 Boiler room: Every boiler or combination boiler and cooling unit shall be installed in a space which allows a minimum clearance of twenty-four (24) inches on all service sides. Such room shall be constructed of at least one (1) hour fireresistance rated construction, and the door shall be a Class C fire door or a one and three-quarters (1¾) inch solid wood core door. Such door shall be equipped with an automatic self-closer. Combustion air shall be provided to such room in conformance with Article 6. Storage or living quarters shall not be permitted in any boiler or similar heating equipment room.

Exception: One- and two-family dwellings, except for combustion air requirements as set forth in Article 6.

M-423.5 Steam and hot water pipes: Steam and hot water pipes shall be installed with a clearance of at least one (1) inch to all combustible material except as specified in subsequent Sections M-423.5.1 through M-423.5.3.

M-423.5.1 Low pressure: At points where pipes carrying steam or hot water under pressures not over fifteen (15) pounds per square inch gauge (psig) emerge from a floor, wall or ceiling, the clearance at the opening through the floor, wall or ceiling shall be at least three-eighths (⅜) inch. Such openings shall be rodent-proof.

M-423.5.2 High pressure: Clearance to combustible material, and covers for such openings, for high pressure steam pipes and high temperature hot water pipes shall be subject to approval by the building official.

M-423.5.3 Hot water pipes on a system with automatic firing and with limit controls such that water temperature at the boiler cannot exceed two hundred fifty (250) degrees F. may be installed without clearance requirements.

M-423.6 Pipes through shelving: Steam pipes and hot water pipes passing through stock shelving shall be covered with noncombustible insulation not less than one (1) inch in thickness. Wooden boxes or casings enclosing steam or hot water pipes shall be of noncombustible material. Coverings shall be of an approved flame-proof material. Where steam pipes or hot water pipes pass through a floor, wall or ceiling of fireresistive construction, the openings shall be filled with noncombustible material which will permit pipe expansion.

M-423.7 Antifreeze solutions for radiant heating coils: Antifreeze solutions used in radiant heating coils within a building shall not contain any liquid with a flash point less than two hundred twenty-five (225) degrees F.

M-423.8 Air cooling equipment: See Article 8.

M-423.9 Flue exhausters: Flue exhausters may be used with large gas-fired sectional boilers and other large hot water and steam boilers when natural draft cannot be secured by the building flue or chimney. Where a flue exhauster is used with gas-burning appliances, it shall be subject to approval, and provisions shall be made to prevent the flow of gas to the main burners in the event of failure of the flue gas exhaust system.

SECTION M-424.0 WELDING OF PIPE JOINTS

M-424.1 General: All welded connections shall be so designed and fabricated as to permit thorough penetration of the welds to the bottom of the joints, and all welds shall be made in conformance with the general requirements specified herein and by the American Welding Society Standards listed in Appendix B.

M-424.2 Materials: The materials to be welded shall be of good weldable quality, free from laminations, split seams, harmful ingredients, and other defects. The filler metal, electrodes, and welding wire or rods shall be suitable for use with the base metals to be welded.

M-424.3 Preparation for welded joints

M-424.3.1 Butt welds: Butt welds may be of either the single "V" double "V" or "U" bevel. The edges of the parts to be jointed shall be beveled and spaced as required, and the welding procedure shall be such as to insure complete penetration of the deposited metal to the bottom of the joint and thorough fusion of the deposited metal with the base metal. Ferrules or backing strips inside the pipe may be used if properly secured and thoroughly fused to the weld. Care should be exercised not to burn through the ferrule or backing strips or rings. Welds shall not have depressions at the edges below the surfaces of the part joined and shall be so built up that a gradual increase in thickness from edge to center is accomplished.

M-424.3.2 Fillet welds: Fillet welds may be either of the single or double fillet type, and the welding procedure shall be such as to insure complete penetration and thorough fusion of the deposited metal with the base metal. A fillet weld shall not have a throat less than seventy-five hundredths (0.75) times the nominal size of the weld.

M-424.3.3 Seal welds: Seal welds shall not be considered as contributing to the strength of the joints. Seal welds may be of either butt or fillet type and shall be made as small in cross-section as practicable to insure tightness and minimize heating of the parts sealed. When applied to pipe joints where strength is supplied by other parts, the seal welding shall be accomplished so as to avoid undue straining of the joint structure due to temperature changes.

M-424.4 Cast iron and non-ferrous materials: Where welding of cast iron and non-ferrous materials is permitted, they shall be welded with suitable filler metal and method as recommended by the American Welding Society and approved by the building official.

M-424.5 Welding flanges, valves, fittings and other piping equipment

M-424.5.1 Flanges, valves, fittings and other piping equipment which is to be welded shall be provided with suitable welding ends. The design of such ends shall be such that damage will not result from proper welding or stress-relieving which would render the equipment inoperative or unsafe for service.

M-424.5.2 Tees, ends, branch connections, swages and other fittings may be formed from pipe, provided the design and fabrication conform to the requirements of this section.

M-424.6 Welding procedure

M-424.6.1 Beveling shall be by machine; however, this may be performed with a torch if the surfaces are thoroughly cleaned of scale and oxidation after the work has been performed.

M-424.6.2 Surfaces for welding shall be thoroughly cleaned and shall be free from paint, oil, rust or scale prior to welding.

M-424.6.3 Before welding, the piping or other equipment shall be carefully aligned. This alignment shall be preserved during welding.

M-424.6.4 The length of tack welds shall be approximately twice the thickness of the thinner material joined. Tack welds shall be kept below the outside surface and shall be melted out during welding or otherwise removed.

M-424.6.5 All welds shall be of sound metal, thoroughly fused to the base metal.

M-424.6.6 Excess weld metal shall not project within the pipe.

M-424.6.7 The thickness of the reinforcement for all butt welds shall be one-half (½) the thickness of the parent metal.

M-424.7 Preheating and stress relieving: Welded pipe joints under the provisions of this article shall be pre-heated and stress relieved as indicated in the following Sections M-424.7.1 through M-424.7.4.

M-424.7.1 Carbon steel pipe, preheating: Carbon steel pipe that has a wall thickness of one-half (½) inch or greater and that has a carbon content of thirty-five (35) per cent or more shall have the welding zone preheated from four hundred (400) degrees F. to six hundred (600) degrees F.

M-424.7.2 Carbon steel pipe, stress relieving: Carbon steel pipe that has a wall thickness of one-half (½) inch or greater and that has a carbon content of thirty-five (35) per cent or more shall have the weld stress relieved by heating to a temperature of twelve hundred twenty-five

(1225) degrees F. and held for a period of one-half (½) hour per one-half (½) inch of thickness of pipe and shall be allowed to cool slowly in still air.

M-424.7.3 **Low alloy piping materials:** The welded zone shall be preheated to a temperature of from four hundred (400) degrees F. to six hundred (600) degrees F. When the nominal wall thickness is one-half (½) inch or greater, the weld shall be uniformly heated to a temperature of not less than thirteen hundred seventy-five (1375) degrees F. and held at temperature for a period of not less than one (1) hour for each one-half (½) inch of thickness and then allowed to cool in still air.

M-424.7.4 When making the local stress relief, the following conditions shall be met.

1. For welded joints in piping, the width of the heated circumferential band shall be at least three (3) times the width of the widest part of the welding groove, but not less than twice the width of the weld reinforcement.
2. For welded nozzles or other welded attachments, the width of the heated circumferential band around the entire header and nozzle, with attachment in center, shall be at least twelve (12) times the thickness of the header wall, plus the diameter of the nozzle or attachment.
3. At the termination of the soaking period, the zone weld shall be wrapped with three (3) or four (4) layers of asbestos in order to assure slow and uniform cooling. When test data is required, temp-sticks or indicating or recording type pyrometer shall be used in recording the temperature of the stress relieving operation.

M-424.8 Testing

M-424.8.1 All welded piping work shall be inspected for the pressure tests specified. Welds may be checked by trepanning out a coupon large enough to show a clear cross-section of the weld. Such coupon shall be ground smooth at both sections of the weld and deeply etched for examination. Both etched sections of the weld shall pass examination required for the fractured surfaces of the weld in nick-break test specimen. If the weld proves satisfactory, the hole shall be closed by welding in a steel plug or other suitable piece of material, with care being taken to minimize strains due to heating.

M-424.8.2 Piping and associated equipment fabricated with welded joints shall be capable of withstanding hydrostatic shell tests of not less than one and one-half (1½) times the working pressure, or as specified.

M-424.9 Acceptance and rejection

M-424.9.1 General sweating of any weld is cause for its rejection, complete removal and rewelding.

M-424.9.2 If inspection of a weld indicates failure to meet the test prescribed, such weld shall be rejected.

ARTICLE 5

BOILERS AND PRESSURE VESSELS, MAINTENANCE AND INSPECTION

SECTION M-500.0 GENERAL

M-500.1 Scope: In addition to the other requirements of this code, this article shall govern the maintenance and safety of all steam boilers, steam cleaners and steam generators, presently installed or hereafter erected. This article shall also govern the annual inspection and fees imposed for such inspections.

M-500.2 Equipment: Such equipment shall be constructed, installed and maintained in accordance with this code and the applicable standards listed in Appendix B and shall be approved by the building official.

M-500.3 Use of intended fuel: Gas or oil appliances shall not be converted from the fuel intended for use to a different fuel, except when converted in accordance with the manufacturer's instructions and approved by the building official.

M-500.4 Boiler operator certificate of fitness: It shall be unlawful for any person to operate a steam boiler of more than ten (10) horsepower or a boiler designed to carry a steam pressure of more than fifteen (15) pounds per square inch (psi) without a certificate of fitness from the building official or authorized jurisdictional agency (see Section M-423.4).

M-500.5 Renewal of certificate: The certificate of fitness shall continue in force for a period of one (1) year unless revoked or suspended, and applications shall be made for renewal annually.

M-500.6 Combustion air: Combustion air shall be as required in Article 6 and there shall be a permanent opening to the outside atmosphere without restrictions.

M-500.7 Boiler rooms: Boiler rooms shall be maintained free of rubbish and storage and shall be constructed to meet the fire separation requirements of this code and the building code.

M-500.8 Prohibited installations: Steam cleaners and steam generators shall not be maintained on the floor of any garage, wash rack, auto wash, or any building into which gasoline or butane-propelled devices such as automobiles, trucks or like devices can be driven.

SECTION M-501.0 INSPECTIONS

M-501.1 Periodic inspections: All boilers and unfired .pressure vessels subject to the provisions of this code shall be inspected at least once annually by the building official or other municipal authority or by an agency acceptable to the building official.

Exception: One- and two-family dwelling occupancies.

M-501.2 Certificate of inspections: A boiler or unfired pressure vessel subject to the provisions of this code shall not be placed in operation until a certificate of inspection and approval has been issued.

M-501.3 Boiler record: The building official shall maintain a file of all such boilers and unfired pressure vessels with a record of all inspections, together with the official recommendations and actions thereon.

M-501.4 Major repairs: Equipment shall not be used after major repairs until an inspection has been made by the department to ascertain that such repairs have been completed in an approved manner.

M-501.5 Owners to provide facilities: Every person owning or having possession or control of any such equipment subject to inspection as aforesaid shall provide, at his own expense, proper arrangements and facilities for attaching the instruments of inspection. Immediately before the time set for such inspection, every such person shall remove all scale, dirt, soot, and sediment in, beneath and around such equipment and fill the same with water, when required to do so by the department and shall have all main stop valves and other valves and connections on such equipment perfectly tight, so that the department may be able to apply hydrostatic pressure, leaving all said equipment in clean condition for inspection.

M-501.6 Equipment testing and additional fee: All equipment, when required to be tested by hydrostatic pressure, shall be filled with water by the owner or users, and they shall furnish the necessary labor required to work and handle the pumps in applying the test. When leaks occur which prevent a successful test, the department shall make a second test upon receiving notice that all leaks have been repaired. If, upon making a second test, such equipment is still defective, the owner or user thereof shall, for each subsequent test, pay an additional inspection fee as herein provided, but a certificate of inspection shall not be issued until testing has been successfully completed.

M-501.7 Hydrostatic pressure: It shall be the duty of the department to inspect all such equipment annually by conducting a hydrostatic pressure test where such test by the department shall be deemed necessary and by making a careful external, where possible, and internal, where possible, examination after testing. The hydrostatic pressure used in such test shall not exceed the maximum working pressure of said equipment by more than fifty (50) per cent.

M-501.8 Test formulae: In certifying the working pressure permitted on each such equipment, the department shall use approved ASME test formulae (see Appendix B).

M-501.9 Drill inspection: Any such equipment having been in use eight (8) years or more, and its condition being such that, in the opinion of the department, the same should be drilled in order that the exact thickness and condition thereof may be ascertained, such equipment shall be drilled by the owner or user at points in such equipment as the department may direct, and the steam pressure or other pressure allowed shall be governed by such ascertained thickness and general condition of the equipment. Drilling and plugging shall be performed at the expense of the owner or user.

M-501.10 Seller's inspection: All manufacturers or other persons selling such equipment, either new or used, shall, before painting the same, have it inspected by the department and shall have in their possession a certificate issued by the inspector indicating the amount of pressure per square inch the equipment is permitted to carry. The certificate shall be furnished by the seller to the buyer.

M-501.11 Welding: All welding shall be performed in accordance with the requirements of Article 4.

M-501.12 Electrical: All electrical wiring shall conform to the requirements of the electrical code of this jurisdiction.

M-501.13 Boiler settings: Boiler settings shall be as required for furnace settings in Articles 3 and 4.

SECTION M-502.0 ANNUAL INSPECTION FEES

M-502.1 General: Annual inspection fees shall be established in accordance with the following Table M-502.

SECTION M-503.0 CONDEMNATION

M-503.1 General: Any boiler or pressure vessel, which in the opinion of the department constitutes a hazard, shall be red-tagged and condemned in accordance with the provisions of Article 6.

Table M-502
INSPECTION FEE SCHEDULE

Power boilers	
Horsepower	**Fee**
0 to 50	________
51 to 100	________
101 to 250	________
251 to 500	________
501 to 1,000	________
1,001 and over	________

Heating boilers	
Pressure or area	**Fee**
Cast iron, 15 lbs. per sq. in. or less in pressure	________
0 to 1,400 sq. ft. radiation	________
1,401 to 5,000	________
5,001 to 10,000	________
10,001 to 25,000	________
25,001 and over	________

Note. 33,475 Btuh = 1 HP
3,300 to 8,000 Btuh = 1 sq. ft. radiation
All inspections, other than the normal required, shall be assessed ________________ for each additional inspection.

ARTICLE 6

GAS, LIQUID AND SOLID FUEL PIPING AND EQUIPMENT

SECTION M-600.0 GENERAL

M-600.1 Scope: In addition to other requirements in this code, this article shall govern the installation, repair and maintenance of gas, liquid and solid fuel piping and appliances.

M-600.2 Obstruction: All piping shall not obstruct access to blowers, motors, filters or controls.

M-600.3 Boiler-furnace safety devices: Boilers or furnaces shall be equipped with approved safety devices arranged to limit high steam pressures, or water temperatures or air temperatures in warm air furnaces.

M-600.4 Prohibited installation of heating appliances, devices or appurtenances, new or existing buildings

M-600.4.1 It shall be unlawful to install or cause to be installed, or use any and all unvented gas, oil and solid fuel-fired heating appliances for use within the corporate limits of this jurisdiction unless otherwise provided for in this code and approved by the department.

M-600.4.2 Vented gas, oil and solid fuel-fired appliances shall not be installed in bedrooms, bathrooms, toilet rooms, or rooms used for sleeping purposes in new or existing structures, unless such equipment to be used in the above areas is specifically approved by the department or unless otherwise approved as follows.

> **Exception:** Appliances, devices, or apparatus to be used in bathrooms, toilet rooms, bedrooms or rooms used for sleeping purposes shall be of the sealed combustion chamber type (through-the-wall heaters), so that the air for combustion and the combustion and flue gases are completely sealed off from any of the aforementioned areas. Further, such equipment shall be approved by a nationally recognized testing or inspection agency (see Article 3 for further requirements).

SECTION M-601.0 HOUSE GAS PIPING

M-601.1 Materials required: House gas piping shall be at least standard weight wrought iron or steel pipe.

M-601.1.1 Gas pipe shall either be new or shall previously not have been used for any other purpose than the conveying of gas.

M-601.1.2 Gas pipe shall be free from internal obstructions, splits, or other imperfections which would render it unfit for the purpose intended, and the ends thereof shall be properly reamed.

M-601.1.3 The use of soldered joints is prohibited.

M-601.1.4 Running threads or long screw points are prohibited.

M-601.1.5 Bushings, unions and compression-type couplings shall not be used in concealed work.

M-601.1.6 The use of thread or joint compound, or lubricant (pipe dope) is permitted when properly and sparingly applied to the male threads only. Such compounds shall be approved for the type of gas used.

M-601.2 Installation

M-601.2.1 Riser tees: A tee shall be placed at the bottom of all risers in any gas piping. The bottom openings of the tee shall be provided with a long nipple and cap the same size as the vertical pipe.

M-601.2.2 Support: All gas piping shall be rigidly supported at intervals of not more than ten (10) feet by approved metal straps or hangers in such a manner so as to prevent shifting or dislocation. Straps or hangers of aluminum or of combustible materials shall not be permitted.

M-601.2.3 Branches: All branches from horizontal runs shall be taken from sides or tops of such runs.

M-601.2.4 Stop-cock: In buildings or dwellings occupied by one (1) or more families, every gas outlet hereafter connected to a gas appliance shall be equipped with an approved stop-cock adjacent to the appliance.

M-601.2.5 Coatings or wrappings: When gas piping is used on the exterior of a building or exposed to unusually damp conditions, it shall be coated or wrapped with approved protective covering.

M-601.2.6 Concealed piping: Where piping is concealed, all plugged or capped openings shall be exposed and accessible.

M-601.2.7 Prohibited installations: Gas piping shall not be installed in or through chimneys, hoistways, vents or in ventilating ducts or shafts.

SECTION M-602.0 UNDERGROUND OUTSIDE GAS PIPING

M-602.1 General: The provisions of this section shall apply to underground outside metered gas piping.

M-602.2 Material: All pipe shall be approved standard weight wrought iron, steel, black or galvanized. All fittings shall be constructed of like material as required for pipe.

Exception: In systems where the natural gas capacity is less than one thousand (1,000) cubic feet per hour, internally tinned Type L copper tubing, plastic tubing and plastic pipe meeting the requirements of standards listed in Appendix C shall be permitted in underground installations. Plastic pipe or tubing shall bear the manufacturer's stamp indicating compliance with the applicable standards. Systems of this type employing more than one thousand (1,000) cubic feet per hour of natural gas, and all liquefied petroleum gas installations, shall be approved by the department.

M-602.3 Prohibited installation: Pipe shall not be laid on the ground and subsequently covered by concrete or masonry. Pipe shall not be laid on the ground surface where it may be subjected to mechanical injury.

M-602.4 Depth: All piping shall be installed at least fifteen (15) inches below the surface of the ground.

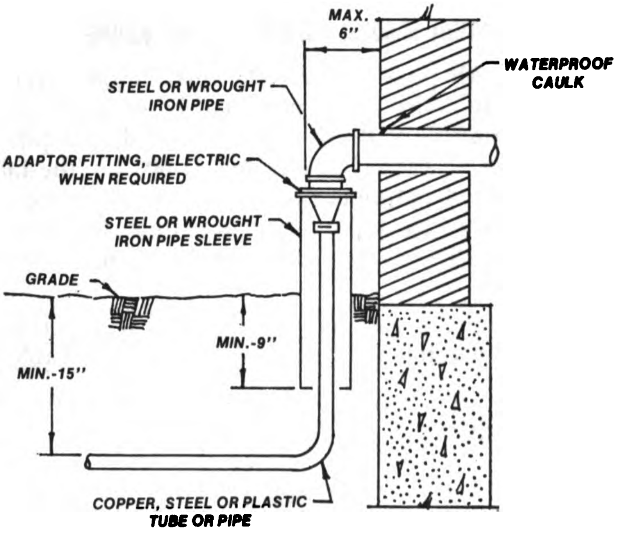
M-602.5 Pipe entry into building: All piping shall enter into the building above grade.

M-602.6 Coatings-wrappings: All steel, wrought iron pipe or steel tubing and all ferrous fittings laid in the earth shall be wrapped or coated in a manner equivalent to AWWA specifications as indicated in Appendix B. Copper pipe, tubing or plastic pipe or tubing need not be wrapped or coated.

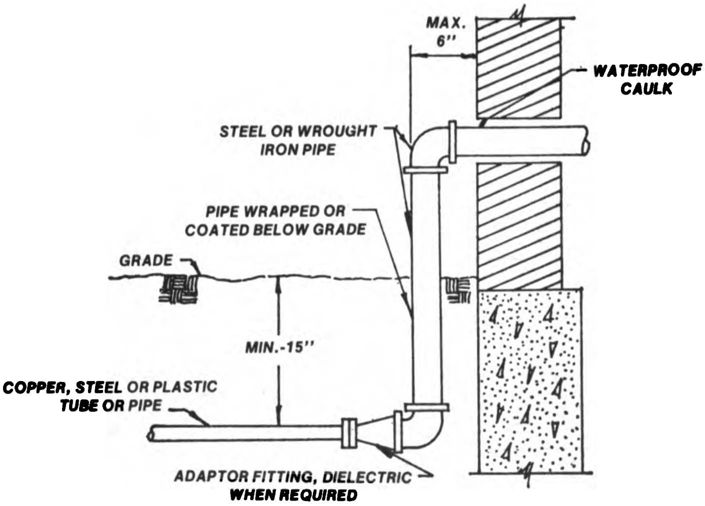
M-602.7 Connections

M-602.7.1 When underground plastic tube or pipe, steel tube or copper tube is supplied from interior gas piping, the interior piping shall be extended through the outside wall, above grade, with steel or wrought iron pipe. Underground connections made to the copper tube, steel tube, or plastic tube or pipe, shall be made at a point at least fifteen (15) inches below the surface of the ground. Above ground connections shall be provided with a protective steel or wrought iron pipe sleeve. The sleeve shall extend from a point nine (9) inches below the ground surface to a rigid connection with the extended interior house gas piping. The exterior gas-carrying pipe or its protective sleeve shall be not more than six (6) inches from the outside face of the building wall. The underground portion of the gas-carrying steel or wrought iron pipe must be wrapped or coated. The opening in the foundation or wall through which the extended pipe passes shall be sealed with waterproof material (see Figure M-602.7).

M-602.7.2 Connections between the steel or wrought iron pipe and plastic, copper or steel tube shall be made with approved type adaptor fittings. Dielectric-type fittings shall be used where metals are dissimilar.


MAX. 6''
WATERPROOF CAULK
STEEL OR WROUGHT IRON PIPE
ADAPTOR FITTING, DIELECTRIC WHEN REQUIRED
STEEL OR WROUGHT IRON PIPE SLEEVE
GRADE
MIN.-9''
MIN.-15''
COPPER, STEEL OR PLASTIC TUBE OR PIPE

ABOVE GROUND CONNECTION


MAX. 6''
WATERPROOF CAULK
STEEL OR WROUGHT IRON PIPE
PIPE WRAPPED OR COATED BELOW GRADE
GRADE
MIN.-15''
COPPER, STEEL OR PLASTIC TUBE OR PIPE
ADAPTOR FITTING, DIELECTRIC WHEN REQUIRED

UNDERGROUND CONNECTION

Figure M-602.7
UNDERGROUND OUTSIDE GAS PIPING

SECTION M-603.0 SIZING OF GAS PIPING

M-603.1 General: All pipe used for the installation, extension, alteration and repair of any house gas piping shall be of ample size to supply the full number of outlets of the purpose intended, and pipe sizes shall be determined by use of Table M-603.1 and M-603.1.1 (the tables are not to be used for liquefied petroleum gas). To determine the size of each section of piping in a gas piping system within the range of Table M-603.1, proceed as indicated in the following Sections M-603.1.1 through M-603.1.7.

M-603.1.1 Determine the gas demand in cubic feet per hour of each of the appliances to be attached to the piping system (Table M-603.1.1).

M-603.1.2 Measure the length of piping from the gas meter to the outlet which is the farthest from the meter.

Table M-603.1

MAXIMUM CAPACITY OF PIPE IN CUBIC FEET OF GAS PER HOUR (BASED ON A 0.60 SPECIFIC GRAVITY GAS)

Gas pressures of 0.5 psig or less and a pressure drop of 0.3 inch water column

Nominal Iron Pipe Size, Inches	Internal Diameter, Inches	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
¼	.364	32	22	18	15	14	12	11	11	10	9	8	8	7	6
⅜	.493	72	49	40	34	30	27	25	23	22	21	18	17	15	14
½	.622	132	92	73	63	56	50	46	43	40	38	34	31	28	26
¾	.824	278	190	152	130	115	105	96	90	84	79	72	64	59	55
1	1.049	520	350	285	245	215	195	180	170	160	150	130	120	110	100
1¼	1.380	1,050	730	590	500	440	400	370	350	320	305	275	250	225	210
1½	1.610	1,600	1,100	890	760	670	610	560	530	490	460	410	380	350	320
2	2.067	3,050	2,100	1,650	1,450	1,270	1,150	1,050	990	930	870	780	710	650	610
2½	2.469	4,800	3,300	2,700	2,300	2,000	1,850	1,700	1,600	1,500	1,400	1,250	1,130	1,050	980
3	3.068	8,500	5,900	4,700	4,100	3,600	3,250	3,000	2,800	2,600	2,500	2,200	2,000	1,850	1,700
4	4.026	17,500	12,000	9,700	8,300	7,400	6,800	6,200	5,800	5,400	5,100	4,500	4,100	3,800	3,500

Gas pressures of 0.5 psig or less and a pressure drop of 0.5 inch water column

Nominal Iron Pipe Size, Inches	Internal Diameter, Inches	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
¼	.364	43	29	24	20	18	16	15	14	13	12	11	10	9	8
⅜	.493	95	65	52	45	40	36.	33	31	29	27	24	22	20	19
½	.622	175	120	97	82	73	66	61	57	53	50	44	40	37	35
¾	.824	360	250	200	170	151	138	125	118	110	103	93	84	77	72
1	1.049	680	465	375	320	285	260	240	220	205	195.	175	160	145	135
1¼	1,380	1,400	950	770	660	580	530	490	460	430	400	360	325	300	280
1½	1.610	2,100	1,460	1,180	990	900	810	750	690	650	620.	550	500	460	430
2	2.067	3,950	2,750	2,200	1,900	1,680	1,520	1,400	1,300	1,220	1,150	1,020	950	850	800
2½	2.469	6,300	4,350	3,520	3,000	2,650	2,400	2,250	2,050	1,950	1,850	1,650	1,500	1,370	1,280
3	3.068	11,000	7,700	6,250	5,300	4,750	4,300	3,900	3,700	3,450	3,250	2,950	2,650	2,450	2,280
4	4.026	23,000	15,800	12,800	10,900	9,700	8,800	8,100	7,500	7,200	6,700	6,000	5,500	5,000	4,600

M-603.1.3 In Table M-603.1, select the vertical column showing this farthest distance or the next longest distance if the table does not give the exact distance. This vertical column (farthest distance) shall be used in sizing all sections of pipe in the piping system.

M-603.1.4 Starting at the farthest outlet from the meter, find in the vertical column just selected, the gas demand for that outlet as determined above (see Section M-603.1.1). If the exact gas demand figure is not shown, choose the next largest figure in the same vertical column.

M-603.1.5 Opposite this demand figure (in the column headed "Nominal iron pipe size inches") find the correct size of pipe to be used. This pipe size is only for that section of pipe carrying the gas demand for the outlet under consideration.

M-603.1.6 Proceed in a similar manner for each outlet.

M-603.1.7 After each outlet has been sized, then size each section of pipe carrying the gas demand for more than one (1) outlet. This is done by determining the total gas demand supply by each section and using that figure in the farthest distance vertical column as determined in Section M-603.1.3 (the same distance used in the above calculation).

M-603.2 An allowance is not necessary for an ordinary number of fittings.

Table M-603.1.1

APPLIANCE GAS DEMAND

(Based on natural gas having a Btu content of 840 at 60° F. and 24.7 inches of mercury.)

Appliance	Cubic feet per hour		
	Small*	Average*	Large*
Domestic range	50	70	90
Domestic water heater (storage type)	30	50	75
Domestic space heaters (circulating)	20	40	60
Domestic floor type furnace	25	50	75
Domestic central type furnace	75	125	200
Domestic central type boilers (steam or hot water)	75	125	200
Commercial range (restaurant)	150	200	250
Commercial griddle or hot plate	20	40	60
Commercial steam table, per burner	...	15	...
Commercial coffee urn	10	25	35
Steam boilers, per horsepower	...	60	...
Industrial appliance	Requires individual determination.		

*Not to be used for setting appliance gas input.

SECTION M-604.0 MINIMUM SIZE OF GAS PIPE

M-604.1 General: The diameter of supply pipe to any gas appliance shall not be of smaller size than the inlet connection of such gas appliance.

M-604.2 Remodeling: In remodeling or extending existing house gas piping, connections shall be made only where sizes can be maintained in accordance with Table M-603.1.

SECTION M-605.0 LEAK TEST METHODS FOR GAS PIPING SYSTEMS

M-605.1 Pressure: Before appliances are connected, piping systems shall stand a pressure of at least six (6) inches mercury or three (3) pounds gauge for a period of at least ten (10) minutes without showing any drop in pressure. Pressure shall be measured with a mercury manometer or slope gauge or an equivalent device so calibrated as to be read in increments of not greater than one-tenth (1/10) pound. The source of pressure shall be isolated before the pressure tests are made.

M-605.2 Liquefied petroleum gases (LPG): Systems for undiluted liquefied petroleum gases shall stand the pressure test in accordance with Section M-605.1, or, when appliances are connected to the piping system, shall stand a pressure of not less than ten (10) inches water column for a period of not less than ten (10) minutes without showing any drop in pressure. Pressure shall be measured with a water manometer or an equivalent device so calibrated as to be read in increments of not greater than one-tenth (1/10) inch water column. The source of pressure shall be isolated before the pressure tests are made.

M-605.3 Method: Leaks in gas piping shall be located by applying soapy water to the exterior of the piping. Fire or acid shall not be used to locate leaks nor shall water be introduced into the gas piping.

SECTION M-606.0 PURGING GAS PIPING

M-606.1 General: All gas piping shall be fully purged. Piping shall not be purged into the combustion chamber of an appliance.

M-606.2 Discharge: The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition unless precautions are taken to perform this operation in a safe manner by ventilation of the space, control of purging rate and elimination of all hazardous conditions.

SECTION M-607.0 CAPPED OUTLETS FOR GAS PIPING

M-607.1 General: Gas fixtures or appliances shall not be removed or disconnected without capping or plugging with a screwed joint fitting the outlet from which said fixtures or gas appliances were removed. All outlets to which fixtures are not connected shall be left capped or plugged gas tight. Any such plugged or capped opening shall be left accessible.

SECTION M-606.0 FUEL OIL TANKS AND EQUIPMENT

M-608.1 General: All fuel oil storage tanks, piping, vents, and valves shall be installed in compliance with the building code, this code, and accepted engineering practice as defined in the applicable standards listed in Appendix B.

M-608.2 Integral tanks: A tank for the storage of six (6) gallons or less of fuel oil shall be considered an integral part of the burner installation and shall be included in the approval of the burner.

M-608.3 Separate tanks: All tanks of more than six (6) gallons capacity shall be constructed of materials of approved quality and thickness and shall meet the requirements of the applicable engineering standards listed in Appendix B.

M-608.4 Storage tank identification: At the time of installation, a storage tank shall have permanently and prominently affixed thereto a permanent identification tag certifying that it has been tested according to nationally recognized standards. Said certification shall also bear the name of the tank manufacturer, the gage thickness of the material of which the tank was constructed and its capacity.

M-608.5 Tank vents: All fuel oil storage tanks shall be equipped with an approved relief vent discharging to the outside air. The vent opening and vent pipes shall be designed to prevent abnormal pressure in the tank during filling, but such vents shall not be less than one and one-quarter (1¼) inch iron pipe size.

M-608.6 Vent discharge outlet: The vent pipe from fuel oil tanks shall terminate outside the building with the discharge end located not less than two (2) feet vertically and horizontally from any window, skylight or roof structure opening in the same or any adjoining building, not more than twelve (12) feet above the fill pipe terminal, nor lower than the fill pipe terminal. The tops of such vents shall be protected with a weatherproof hood.

M-608.7 Fuel oil preheaters: Where oil preheaters, used to bring fuel oil to its proper atomizing temperature and viscosity, are installed, they shall be of an approved type equipped with a relief valve to prevent excessive oil pressure. The relief valve shall be set to discharge at one and one-half (1½) times the working pressure of the oil supply system.

SECTION M-609.0 ERECTION AND INSTALLATION OF APPLIANCES

M-609.1 General: Appliances shall be erected and installed in accordance with the terms of their listing, the manufacturer's instructions; and accepted engineering practices as indicated in Appendix B.

M-609.2 Safety devices: Each appliance shall be provided with approved safeguards and protective devices to control fuel supply, air mixing, ignition, high temperature or pressure, high and low water limits, and for the control of the burner when ignition fails as described in this code and the building code.

M-609.3 Rigid connections: Except as otherwise permitted herein, every appliance shall be rigidly connected to the supply piping with pipe and fittings appropriate to the intended application as specified in other sections of this code.

M-609.4 Appliance shut-off devices: Each appliance fuel connection shall include an accessible fuel shut-off device. Gas appliances shall have a ground joint union outside of, and adjacent to, the appliance. This union shall be installed between the fuel shut-off device and the appliance.

M-609.5 Flexible connectors: Approved flexible metal, fabric and rubber, or rubber tubing permanently equipped with union or screw-type end connectors by the manufacturer may be used for connecting gas appliances designed for fully portable indoor use, such as ironers, dentist's torches, laboratory equipment and similar uses. Such flexible connectors shall not exceed six (6) feet in length. A shut-off valve shall be installed at the point where the connector is connected to the gas supply line.

M-609.5,1 Flexible metal tubing: Approved flexible metal tubing having a nominal diameter not less than the inlet connection to the appliances as provided by the manufacturers of the appliance, and not exceeding six (6) feet in length, may be used to connect overhead mounted unit heaters, infrared heaters, gas ranges and clothes dryers, and other appliances to reduce the effect of jarring and vibration or where rigid connections are impracticable. Flexible metal tubing shall be listed by a nationally recognized testing or inspection agency. Where such flexible metal tubing is used, a fuel shut off device shall be installed at the point where the flexible metal tubing is connected to the fuel supply line. Part of such flexible metal tubing shall not extend through a partition, wall, floor or ceiling of a building or structure.

M-609.6 Gas line pipe or tube: Pipe or tube subject to chemical action by gases shall be suitably lined with material inert to the chemical in the gases.

M-609.7 Gas low pressure cut-out valve: Gas appliances, pump or similar apparatus, capable of producing a vacuum in the gas service pipe, shall not be installed unless a low pressure cut-out valve or other suitable device is provided to prevent the gas pressure at the gas meter outlet from being reduced below three (3) inches water column pressure.

M-609.8 Gas high pressure cut-out: Where air or oxygen under pressure is used in conjunction with the appliance gas supply, a high pressure cut-out, such as a check valve, shall be provided to prevent air or oxygen from entering the gas supply line.

M-609.9 Rating: The input rating of all appliances shall be limited to that listed by a nationally recognized testing or inspection agency. Commencing at two thousand (2,000) feet above sea level, the nameplate input rating of appliances employing atmospheric burners shall be reduced at the rate of four (4) per cent for each one thousand (1,000) feet of additional elevation. Appliances employing burners which utilize a fan to supply combustion air shall have the appliance nameplate rating corrected for increased altitude in accordance with accepted engineering practice.

M-609.10 Instructions: Appropriate operating instructions shall be supplied by the manufacturer or installer of each appliance and posted permanently in a prominent position on the appliance. At a minimum, they shall include igniting, operating, owner maintenance and shut-down procedures.

M-609.11 Identification: Each appliance shall have permanently and prominently affixed thereto a metal plate, tag or other device which certifies that it has been tested. The certification shall also bear the manufacturer's or distributor's name, appliance model number and Btu input and output rating and the type of fuel for which it is certified and listed.

M-609.12 Tests: When installed, each appliance shall be tested for defects and proper functioning throughout the operating range as provided for in this code and manufacturer's instructions.

SECTION M-610.0 REQUIRED AIR FOR COMBUSTION, VENTILATION AND DRAFT HOOD DILUTION

M-610.1 General: The provisions of this section shall apply to appliances that are installed in buildings and which require air for combustion, ventilation and draft hood dilution from within the building. They are not intended to apply to:

1. sealed combustion system appliances which are constructed and installed so that all air for combustion is derived directly from the outside atmosphere via a duct between the combustion chamber and the outside, and all flue gases are discharged to the outside atmosphere via a duct between the combustion chamber and the outside; or
2. enclosed furnaces which incorporate an integral total enclosure and use only outside air via ducts between the internal furnace enclosure and the outside for combustion and draft hood dilution.

M-610.1.1 Appliances shall be installed in a building space in which the facilities for ventilation permit satisfactory combustion of the fuel, the proper venting of the space and the maintenance of ambient temperature at safe limits under normal conditions of use. Appliances shall be located so as not to interfere with proper circulation of air within the confined space. When buildings are so tight that normal infiltration does not meet air requirements, outside air shall be introduced.

M-610.1.2 Air for combustion, ventilation and draft hood dilution for fuel fired appliances vented by natural draft normally shall be obtained by application of one (1) of the methods covered by Sections M-610.2, M-610.3 or M-610.6.

M-610.2 Appliances located in unconfined spaces of unusually tight construction: If the unconfined space is within a building of unusually tight construction, air for combustion, ventilation, and draft hood dilution shall be obtained from outdoors or from spaces (attic or crawl) freely communicating with the outdoors. Under these conditions, a permanent opening or openings having a total unobstructed area of at least one (1) square inch per five thousand (5,000) Btus per hour of total input rating of all appliances in the space shall be provided to supply make-up air to the space. Ducts used to convey make-up air from the outdoors to the space shall be of the same cross-sectional area as the unobstructed area of the openings to which they connect. Such ducts may be connected to receive their air supply from the cold air return of the heating system. The minimum dimension of rectangular air ducts shall be at least three (3) inches.

M-610.3 Appliances located in confined spaces

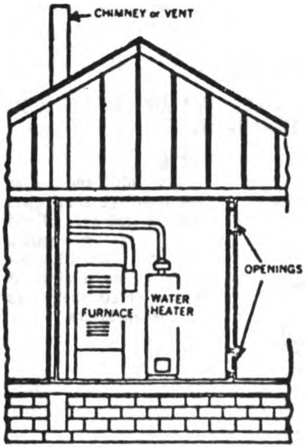
M-610.3.1 All air for combustion, ventilation and draft hood dilution from inside buildings: The confined space shall be provided with two (2) permanent openings, one (1) near the top of the enclosure and one (1) near the bottom. Each opening shall have an unobstructed area of at least one (1) square inch per one thousand (1,000) Btus per hour of the total input rating of all appliances in the confined space which freely communicates with other interior building areas having in turn adequate mechanical ventilation or infiltration from the outside (see Figure M-610.3.1).

M-610.3.2 All air for combustion, ventilation and draft hood dilution from outdoors: The confined space shall be provided with two (2) permanent openings, one (1) in or near the top of the enclosure and one (1) in or near the bottom. The openings shall communicate directly, or by means of ducts, from the confined space to the outdoor air or to such spaces (crawl or attic) that freely communicate with outdoor air.

1. When communicating with outdoor air directly or by means of vertical ducts, each opening shall have an unobstructed area of at least one (1) square inch per four thousand (4,000) Btus per hour of total input rating of all appliances in the enclosure.

Figure M-610.3.1

APPLIANCES LOCATED IN CONFINED SPACES (ALL AIR FROM INSIDE THE BUILDING)



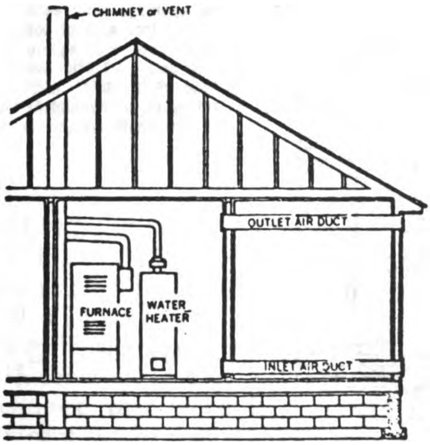
Note: Each opening shall have a free area of not less than one square inch per 1,000 Btus per hour of the total input rating of all appliances in the enclosure.

2. When communicating with outdoor air by means of horizontal ducts, each opening shall have an unobstructed area of at least one (1) square inch per two thousand (2,000) Btus per hour of total input of all appliances in the enclosure.

Ducts shall be of the same cross-sectional area as the unobstructed

Figure M-610.3.2a

APPLIANCES LOCATED IN CONFINED SPACES (ALL AIR FROM OUTDOORS)



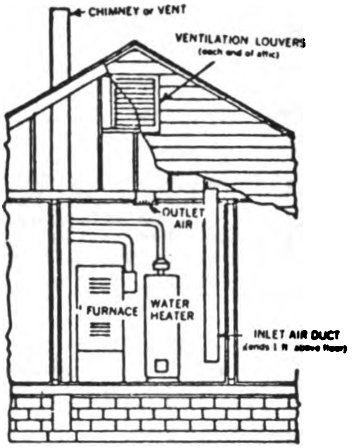
NOTE: Each air duct opening shall have a free araa of not less than one square inch per 2,000 Btus per hour of the total input rating of all appliances in the enclosure.*

***If the appliance room is located against an outside wall and the air openings communicate directly with the outdoors, each opening shall have a free area of not less than one square inch per 4,000 Btus per hour of the total input rating of all appliances in the enclosure.**

area of the openings to which they connect. The minimum dimension of rectangual air ducts shall be at least three (3) inches (see Figures M-610.3.2a, b and c).

Figure M-610.3.2b

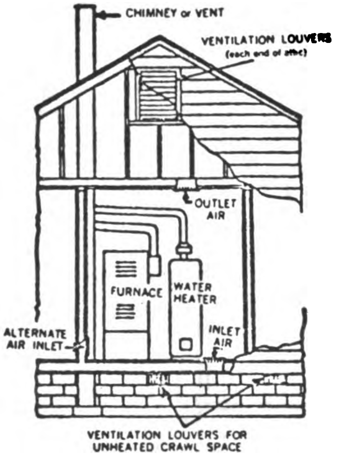
APPLIANCES LOCATED IN CONFINED SPACES (ALL AIR FROM OUTDOORS THROUGH VENTILATED ATTIC)


CHIMNEY or VENT
VENTILATION LOUVERS (each end of attic)
OUTLET AIR
FURNACE
WATER HEATER
INLET AIR DUCT (ends 1 ft above floor)

NOTE:
The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 Btus per hour of the total input rating of all appliances in the enclosure.

Figure M-610.3.2c

APPLIANCES LOCATED IN CONFINED SPACES (ALL AIR FROM OUTDOORS, INLET AIR FROM VENTILATED CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC)


CHIMNEY or VENT
VENTILATION LOUVERS (each end of attic)
OUTLET AIR
FURNACE
WATER HEATER
ALTERNATE AIR INLET
INLET AIR
VENTILATION LOUVERS FOR UNHEATED CRAWL SPACE

NOTE:
The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 Btus per hour of the total input rating of all appliances in the enclosure.

M-610.3.3 Ventilation air from inside buildings, combustion and draft hood dilution air from outdoors: The enclosure shall be provided with two (2) openings communicating with interior building spaces for ventilation, located and sized as described in Section M-610.3.1. In addition, there shall be one (1) opening for combustion and draft hood dilution air directly communicating with outdoors or to such spaces (crawl or attic) that freely communicate with outdoors. This opening shall have an unobstructed area of at least one (1) square inch per five thousand (5,000) Btus per hour of total input of all appliances in the enclosure.

A duct used to convey combustion and draft hood dilution air shall be of the same cross-sectional area as the unobstructed area of the direct opening required. Such ducts may be connected to receive their air supply from the cold air return of the heating system. The minimum dimension of rectangular air ducts shall be at least three (3) inches (see Figure M-610.3.3).

Figure M-610.3.3

APPLIANCES LOCATED IN CONFINED SPACES (VENTILATION AIR FROM INSIDE BUILDING; COMBUSTION AND DRAFT HOOD DILUTION AIR FROM OUTSIDE; VENTILATED ATTIC OR VENTILATED CRAWL SPACES)

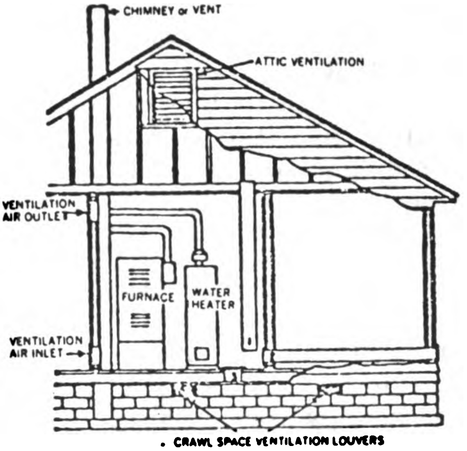
NOTE: Ducts used for make-up air may be connected to the cold air return of the heating system only if they connect directly to outdoor air.

Attic ventilation louvers are required at each end of attic with alternate air inlet No. 1.

1, 2, and 3 mark alternate locations for air from outdoors. Free area shall be not less than 1 square inch per 5,000 Btus per hour of the total input rating of all appliances in the enclosure.

Crawl-space ventilation louvers for unheated crawl space are required with alternate air inlet No. 3.

Each ventilation air opening from inside the building shall have a free area of not less than 1 square inch per 1,000 Btus per hour of the total input rating of all appliances in the enclosure.



M-610.4 Louvers and grilles: In calculating unobstructed area in Sections M-610.2 and M-610.3, consideration shall be given to the blocking effect of louvers, grilles or screens protecting openings. Screens used shall not be smaller than one-fourth (¼) inch mesh. If the unobstructed area through a louver or grille of a given design is known, it shall be used in calculating the size opening required to provide the unobstructed area specified. If, for a given design, the unobstructed area is not known, it may be assumed that wood louvers will have twenty to twenty-five (20-25) per cent unobstructed area, and metal louvers and grilles will have sixty to seventy-five (60-75) per cent unobstructed area.

M-610.5 Special conditions created by mechanical exhausting or fireplaces: Operation of exhaust fans, kitchen ventilation systems, clothes dryers or fireplaces may create negative pressure conditions. If so, special consideration shall be given to avoid unsatisfactory operation of installed gas appliances.

M-610.6 Specially engineered installations: The size of combustion air openings specified in Sections M-610.2 and M-610.3 shall not necessarily govern when special engineering assures an adequate supply of air for combustion, ventilation and draft hoods dilution by other approved methods.

SECTION M-611.0 CHIMNEYS AND VENTS: See Article 7

SECTION M-612.0 FUEL-FIRED APPLIANCES

M-612.1 General: All fuel-fired appliances shall be of an approved type and shall conform to the requirements of this code and shall be installed in accordance with the manufacturer's instructions.

M-612.2 Accessibility: All appliances shall be installed so that burners, orifices, controls, filters, motors, and blowers are readily accessible for observation, inspection and service.

M-612.3 Room access: Means of access to room or space in which gas-fired equipment is located shall conform to Article 3 of this code.

M-612.4 Hazardous location: Fuel-fired appliances shall not be installed in a garage or any other location where flammable vapors are likely to be present, unless the design, operation and installation of said appliance is such as to eliminate the possible ignition of flammable vapors, and unless such appliance and installation is in accordance with the applicable standards listed in Appendix B and the provisions of this code (see Section M-309.0).

M-612.4.1 Open hazards: Fuel-fired equipment shall not be installed so as to constitute or create an indirect or direct fire hazard to other equipment or to the building.

M-612.5 Clearance: Clearance to, and accessibility of, all fuel-fired appliances, except gas-fired incinerators, shall comply with the requirements of this article. Gas-fired incinerators shall comply with the requirements of Section M-623.0 and Article 9.

SECTION M-613.0 GAS RANGES AND PLATES

M-613.1 Prohibited installations: In new or existing buildings, gas ranges and plates shall not be installed in rooms used for sleeping purposes or any other room not adequately ventilated, and shall not be used for space heating purposes.

M-613.2 Exemptions: The vent from the oven of a manually controlled domestic gas range may be omitted. This exemption also applies to the following:

1. any domestic range-oven equipped with automatic means for turning off the gas supply to one (1) or more burners; and
2. any domestic range equipped with automatic means for turning on the gas supply to one (1) or more burners, provided such burners are furnished with automatic ignition means and equipped with an automatic device which, in the event that the means of ignition become inoperative, will automatically shut off the gas supply to such burner.

M-613.3 Venting: Space heaters integral with ranges shall be vented in accordance with Article 7.

M-613.4 Ranges, fryers and broilers: Hotel and restaurant ranges, deep fat fryers and unit broilers may be installed on unprotected combustible floors when set on their own bases or legs when so listed, and when not listed for mounting on a combustible floor, shall be mounted on a noncombustible floor, or be mounted in accordance with Section M-613.4.1 or in some approved manner substantially equivalent thereto.

M-613.4.1 Where the appliance is set on legs which provide at least eighteen (18) inches open space under the base of the appliance, or where it does not have burners and portions of any oven or broiler are not within eighteen (18) inches of the floor, it may be mounted on a combustible floor without special protection, provided there is at least one (1) sheet metal shield between the burner and the floor, and the distance between the shield and the floor shall be at least six (6) inches (for hoods, see Article 3).

SECTION M-614.0 GAS REFRIGERATORS

M-614.1 General: When gas refrigerators are enclosed by adjacent equipment or cabinet or wall surfaces, clearance shall be provided for ventilation around sides, top and bottom of equipment, cabinet, or walls. Whether enclosed or not, the back of the unit shall be at least two (2) inches from any wall.

SECTION M-615.0 WATER HEATERS

M-615.1 Prohibited installations: Fuel fired water heaters shall not be installed in any closet, bathroom, toilet room, room used for sleeping purposes, garage, or in any room or space not properly ventilated. Fuel fired automatic storage water heaters with insulated tank shall have a clearance to combustible materials of at least two (2) inches. Uninsulated tank water heaters shall not be installed in any room where the heat generated will constitute a fire hazard and at least twelve (12) inches clearance to combustibles shall be provided.

M-615.2 Chimneys and Vents: See Article 7.

SECTION M-616.0 STEAM AND HOT WATER BOILERS: See Article 4 and other sections of Article 6.

SECTION M-617.0 FORCED AIR FURNACES: See Article 3.

SECTION M-618.0 GRAVITY WARM AIR FURNACES: See Section M-314.0.

SECTION M-619.0 FLOOR AND WALL-TYPE FURNACES: See Section M-308.0.

SECTION M-620.0 UNIT HEATERS: See Section M-313.0.

SECTION M-621.0 FUEL CONVERSIONS

M-621.1 General: The equipment, in which any conversion burner may be installed, shall be such that it will not endanger life, health or property.

M-621.2 Ventilation: A fuel conversion is prohibited in an appliance located in a room where the normal facilities for ventilation do not permit proper air for combustion, ventilation and draft hood dilution unless special provision is made for supplying sufficient air as prescribed in Section M-610.0.

M-621.3 Installation: All passageways in the appliance, connector pipe and chimney or vents through which products of combustion gases are conducted shall be thoroughly cleaned and made gas-tight before the conversion burners are installed. The burner or burners shall be located according to the manufacturer's instructions and shall be securely fastened in place to prevent twisting, sliding or dropping out of position. The burners shall be installed so as to be readily accessible for cleaning and inspection. The burner or burners shall be so installed that parts of the flames do not impinge so as to cause incomplete combustion, and baffles shall not be applied that will interfere with proper combustion. Where an automatic secondary air control is provided, the construction shall be such that, in case the control fails in any way, either the fuel supply will be shut off or the secondary air door will remain open. Pilot burners shall be supported in such a manner that their position relative to the main burner or burners will be fixed. Pilot burner or burners shall be placed so that they can be safely lighted, and they shall be readily accessible for removal or cleaning.

M-621.4 Draft regulation: An approved draft hood, draft regulator or its equivalent, shall be installed on the vent outlet of the appliance, unless the appliance is listed for use without one. Where this is impossible due to construction limitations or inability to maintain proper combustion conditions in the appliance, an approved alternate method of venting shall be used. Draft hoods and draft regulators shall be located at a point not lower than the top of the highest flue passage in the appliance. Appliances of the revertible flue type shall have the draft hood or draft regulator located at least one (1) foot higher than the top of the highest flue passage.

SECTION M-622.0 LAUNDRY EQUIPMENT

M-622.1 Ventilation: Adequate means shall be provided to properly ventilate the room or space in which laundry equipment is installed and to permit proper combustion of the gas.

M-622.2 Approval: All such equipment shall be erected in accordance with its approval and the manufacturer's instructions.

SECTION M-623.0 FREE STANDING INCINERATORS, GAS FIRED: See also Article 9.

M-623.1 Draft hoods, prohibited: A draft hood shall not be installed in the chimney connector.

M-623.2 Automatic draft regulators: The use of automatic draft regulators is permitted, provided it is so recommended by the manufacturer. Such draft regulators shall be the same size as the incinerator vent and shall be installed according to the manufacturer's recommendations.

M-623.3 Over four bushels: Incinerators in excess of five (5) cubic feet capacity and not of the free standing type shall conform to the requirements of Article 9.

M-623.4 Piping: All gas supply piping shall be at least the standard weight wrought iron or steel pipe sized and installed in compliance with other provisions of this article.

M-623.5 Prohibited locations: Installation of incinerators in garages or enclosed areas containing explosive or flammable liquids is expressly prohibited, unless separated therefrom by at least an eight (8) inch thick masonry wall without openings.

M-623.6 Use of safety thimbles: See Article 7.

SECTION M-624.0 FUEL-FIRED INDUSTRIAL TYPE EQUIPMENT

M-624.1 Scope: In addition to other requirements of this code, the following requirements shall apply to the installation of fuel-fired equipment for boilers, water heaters or appliances which have an input rating in excess of four hundred thousand (400,000) Btus per hour and furnish steam, hot water or warm air for either heating, processing or power purposes. These requirements shall apply to automatically lighted and manually lighted boilers or furnaces as indicated herein.

M-624.2 General: The location and installation of all industrial equipment shall be such that the use of the equipment will not endanger life, health and property. All installations shall comply with the applicable standards listed in Appendix B and shall be approved by the department.

M-624.3 Approval: All industrial appliances and equipment shall be approved by the department.

M-624.4 Combustion air (natural gas, LPG and LPG-air gas): Properly designed permanent facilities for supplying an ample amount of outside air to permit complete combustion of the gas shall be provided. Where combustion air is taken from the space in which the boiler is located, a permanent opening to the outside air shall be provided having an area at least one-half (½) square foot for each one million (1,000,000) Btus per hour input rated at the altitude of this jurisdiction.

M-624.5 Ventilation (natural gas, LPG and LPG-air gas): Adequate ventilation of the boiler or furnace room shall be provided to prevent a dangerous accumulation of gas should any leakage occur. The means for ventilation shall not cause a pressure less than atmospheric in the room at the burner elevation.

M-624.6 Accessibility for cleaning and inspection (natural gas, LPG and LPG-air gas)

M-624.6.1 Observation: Provisions shall be made to permit ready observation of flames under all firing conditions.

M-624.6.2 Accessibility: Sufficient and reasonable accessibility shall be afforded for inspection, cleaning, repair and replacement of all burners, combustion controls and safety devices.

M-624.7 Chimney or vent connections (natural gas, LPG and LPG-air gas): See Article 7.

M-624.7.1 Draft: Adequate means for limiting draft shall be installed for each boiler. When a damper is used to limit chimney draft, positive means shall be provided to lock the damper in position.

M-624.7.2 Dampers: Adjustable (modulating) dampers, where used for control of the fuel-air ratio, shall be equipped with a device to establish minimum and maximum operating limits. The minimum operating limits for such dampers shall be fixed to obtain sufficient air for complete combustion at the minimum burner input (see also Article 7).

M-624.8 Installation of burners and control (natural gas, LPG and LPG-air gas)

M-624.8.1 General: All burners, or burners and their component parts, shall be installed in accordance with the manufacturer's instructions and shall be properly and firmly secured in place to maintain correct alignment in normal use.

M-624.8.2 Adjustment: The burner or burners shall be so installed and adjusted that there will not be injurious flame impingement on walls or heating surfaces that will cause incomplete combustion or damage to boiler parts.

M-624.8.3 Locking devices: Burner parts, when adjustable, shall be provided with suitable locking devices to prevent accidental shifting.

M-624.8.4 Gauzes: Gauzes shall not be used in burner construction.

M-624.8.5 Combustion: Burners shall maintain complete and stable combustion at the minimum rate of firing or during any sudden change in the gasfiring rate between maximum and minimum inputs.

M-624.9 Air intakes (natural gas, LPG and LPG-air gas)

M-624.9.1 Air shutters: Where air shutters are provided, such shall be capable of any desired adjustment and shall be provided with means for preventing accidental change in setting.

M-624.9.2 Air openings: Air openings shall be provided of sufficient area to supply an adequate amount of air for complete combustion under the specified draft conditions and at the maximum rate of firing. The air shall be introduced to assure thorough mixing of the gas and air in order to complete combustion within the space provided for combustion.

M-624.9.3 Automatic air control: Where an automatically operated air control is provided on an automatically lighted boiler, the arrangement shall be such that in case of failure, safe combustion shall continue or the gas shall be shut off.

M-624.9.4 Mixers: When air under pressure is mixed with the gas supply in a mixer and is automatically controlled, effective means shall be provided to prevent air from passing back into the gas line or gas into the air supply. The gas and air supply shall be equipped with suitable controls to prevent gas from entering the burner until sufficient air is available, and in the event of air failure, to shut off the gas supply.

M-624.9.5 Automatic fire rate: On boilers where the firing rate is automatically changed, the air-gas ratio shall automatically be maintained to produce stable combustion at all firing rates.

M-624.10 Pilots (natural gas, LPG and LPG-air gas)

M-624.10.1 General: Each main burner unit shall be equipped with a continuous pilot adequate to assure safe and reliable ignition. Where multiple jet-type burners or burner heads operate as a unit, a sufficient number of pilots shall be used to accomplish proper ignition.

M-624.10.2 Flame safeguard: A flame safeguard so constructed and installed that gas cannot flow to the main burner or burner group unless satisfactory ignition is assured, shall be employed at each burner or group of burners operating as a unit. Such flame safeguard shall be provided for automatically lighted boilers. Gas to main burners and to intermittent or ignition pilots shall be automatically shut off in case of flame failure at point of supervision.

M-624.10.3 Response time: The response time of the flame safeguard to de-energize the gas shut-off device on flame failure shall not exceed five (5) seconds for boilers having inputs in excess of two million, five hundred thousand (2,500,000) Btus per hour. Pilot supervision by such flame safeguard shall be only at the point where the flame will effectively ignite the gas at the main burner or burners. The circuit and devices shall be arranged so that the gas will be shut off in case of electrical failure.

> **Exception:** Any boiler having inputs in excess of two million, five hundred thousand (2,500,000) Btus per hour that has been approved by a nationally recognized testing on inspection agency or by the department.

M-624.10.4 Electric ignition: Electric ignition systems shall ignite only a pilot. The input to the pilot shall not exceed three (3) per cent of the maximum input to the main burner as fired. If ignition of the pilot is not obtained within sixty (60) seconds, the pilot gas shall be turned off automatically. Pilots ignited by automatically or remotely controlled ignition systems shall be supervised as specified by Section M-624-10.2.

> **Exception:** Any gas designed boiler having inputs in excess of two million, five hundred thousand (2,500,000) Btus per hour that has been approved by a nationally recognized testing or inspection agency or the department.

M-624.10.5 Supports: All pilot burners and flame safeguard units shall be supported in such a manner that their position relative to each other and to the flame of the main burner or burners will remain fixed. Means shall be provided to permit ready observation of all three while firing.

M-624.10.6 Access and removal: All pilot burners and flame safeguard units shall be readily accessible and removable for servicing. Pilot burners shall be placed so that they can be safely lighted manually, if required.

M-624.11 Manual shut-off valves (natural gas, LPG and LPG-air gas)

M-624.11.1 Pilot lines: Pilot lines shall be connected to vertical main gas supply lines or to the sides or top of horizontal lines upstream from all gas control valves for each boiler and shall be independently controlled by means of a manually operated pilot firing valve. In multiple burner installations, a manually operated pilot firing valve shall be provided for each pilot (see Figure M-624.11.1).

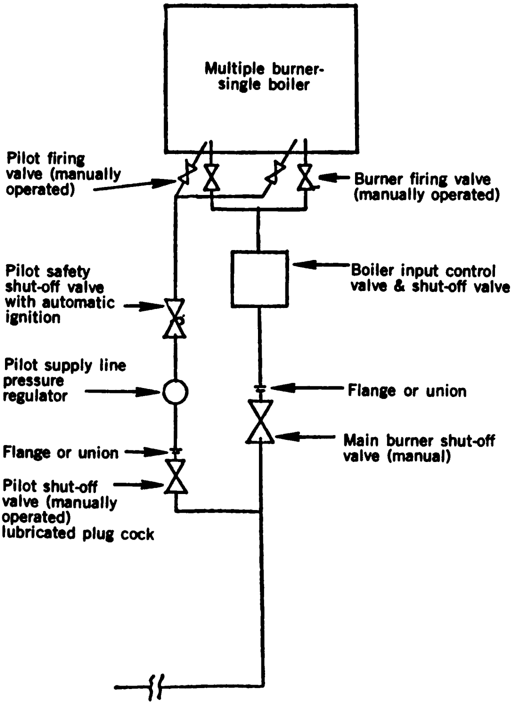
M-624.11.2 Multiple burners: In multiple burner installations, each burner unit, except those utilizing a zero governor inspirator mixer, shall be equipped with a plug-type firing valve with stops at the open and closed positions. The handle shall be permanently attached and parallel to the gas flow in the open position (see Figure M-624.11.2).

M-624.11.3 Shut-off valve (main burner). A manually operated main burner shut-off valve of the lubricated plug type with handle permanently attached shall be installed in the line supplying all main burners of each burner.

M-624.11.4 Shut-off valve (multiple burner): For multiple boiler installations, a manually operated shut-off valve of the lubricated plug-type with handle permanently attached shall be installed in the main line to each boiler. It shall be readily accessible and shall clearly indicate the "on" and "off" positions (see Figure M-624.11.4).

M-624.12 Control valves (natural gas, LPG and LPG-air gas)

Figure M-624.11.1
REQUIREMENTS FOR INSTALLATION OF GAS EQUIPMENT IN LARGE BOILERS


Multiple burner-single boiler
Pilot firing valve (manually operated)
Burner firing valve (manually operated)
Boiler input control valve & shut-off valve
Pilot safety shut-off valve with automatic ignition
Pilot supply line pressure regulator
Flange or union
Main burner shut-off valve (manual)
Flange or union
Pilot shut-off valve (manually operated) lubricated plug cock

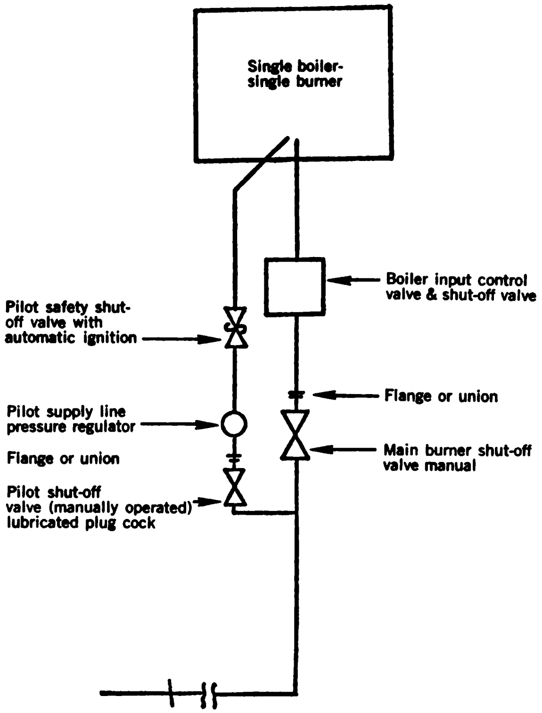
VALVING ARRANGEMENTS FOR A SINGLE BURNER-SINGLE BOILER INSTALLATION
(MANDATORY FOR CONVERSION BURNERS)

M-624.12.1 Location: Boiler input control valves shall be installed downstream from the manual shut-off-valve.

M-624.12.2 Valve assembly: The valve assembly shall be gas-tight in all positions and shall permit easy movement of the valve stems. Valves for "on-off" operation shall be tested to assure gas-tightness of the seal when in the closed position.

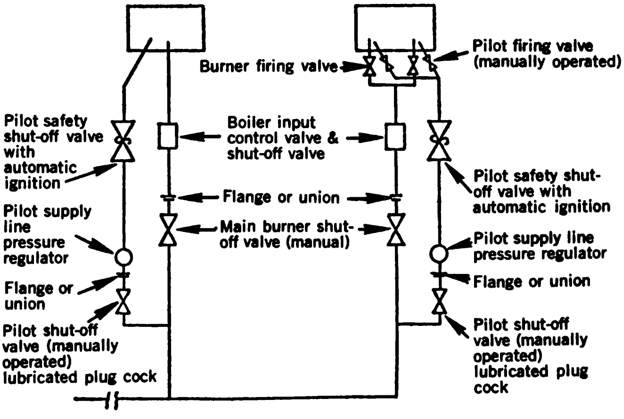
M-624.12.3 Pressure rating: The pressure rating of a valve shall be not less than the gas manifold pressure with all burners shut off.

Figure M-624.11.2
INSTALLATION OF BURNERS AND CONTROLS



VALVING ARRANGEMENT FOR MULTIPLE BURNER, SINGLE BOILER INSTALLATION
(MANDATORY FOR CONVERSION BURNERS)

Figure M-624.11.4
REQUIREMENTS FOR INSTALLATION OF GAS EQUIPMENT IN LARGE BOILERS



VALVING ARRANGEMENT FOR MULTIPLE BOILER INSTALLATION
(MANDATORY FOR CONVERSION BURNERS)

M-624.12.4 Safety shut-off valves: Approved main burner safety shut-off valves shall be required on all boilers where the burner input is in excess of four hundred thousand (400,000) Btus. An additional spring loaded type solenoid gas valve or hydromotor type gas valve shall be installed when a diaphragm type gas valve is installed. This section shall apply to all new or existing installations.

M-624.12.5 Electric shut-off valves: Electrically operated safety shut-off valves shall not depend on electricity to shut off the gas supply.

M-624.12.6 Gas tightness: Means shall be provided for a sensitive test for gas tightness of the safety shut-off valve when in the closed condition.

M-624.12.7 Manually lighted boilers: For manually lighted boilers, either the safety shut-off valve shall incorporate means for reopening the valve after it has closed, or the electrical circuit shall be arranged to require a manual operation to reopen the valve after it has closed. Such valves shall indicate the open and closed positions.

M-624.12.8 Locked by-pass: A locked type by-pass may be installed around the safety shut-off valve subject to the approval of the department.

M-624.12.9 Pressure (manual): All manual pilot valves shall be designed for the maximum pressure to which they will be subjected and shall be of the lubricated plug type.

M-624.13 Gas pressure regulators (natural gas, LPG and LPG-air gas)

M-624.13.1 General: Where gas supply pressure is higher than that at which the burners of a boiler are designed to operate, a gas pressure regulator shall be installed.

M-624.13.2 Pressure: Gas pressure regulators, where used, shall maintain the gas pressure to the burner supply line within plus or minus ten (10) per cent of the operating pressure from maximum to minimum firing rates.

M-624.13.3 Type: Regulators shall be of the spring loaded, dead weight or pressure balance type. Spring or weight loaded regulators shall have springs or weights covered by a suitable housing. A weight and lever type of regulator shall not be used.

M-624.14 Semi-rigid tubing and fittings: Semi-rigid tubing and fittings to be used in main and pilot burner assemblies shall be approved by the department.

M-624.15 Limiting devices (natural gas, LPG and LPG-air gas)

M-624.15.1 General: Automatically lighted boilers shall be equipped with safety devices arranged to prevent excessive steam pressures, water temperatures or air temperatures.

M-624.15.2 Safety device: Approved means shall be provided to guard against firing a dry boiler or one in which the water is dangerously low. Automatically lighted boilers shall be provided with such means.

M-624.15.3 Limit controls: Limit controls shall not depend on electricity to shut off the main gas supply except as approved by the department.

M-624.16 Electrical equipment (natural gas, LPG and LPG-air gas): All wiring and controls shall be capable of safely withstanding the temperatures to which they will normally be subjected as required by the electrical code.

M-624.17 Gas piping and meters (natural gas, LPG and LPG-air gas): Boilers shall be supplied by a gas line direct from the meter, independent from other plant uses, unless otherwise approved by the department.

M-624.18 Size of piping (natural gas, LPG and LPG-air gas): Piping shall be of a size and so installed as to provide a supply of gas sufficient to meet the maximum demand without undue loss of pressure.

M-624.19 Installation of supply piping (natural gas, LPG and LPG-air gas)

M-624.19.1 General: The building structure shall not be weakened by installation of piping.

M-624.19.2 Underground: Underground pipes shall not pass through or below foundation walls into unfrequented spaces below buildings. Pipes for buildings having such spaces shall rise above grade before passing through building walls to indoors.

M-624.19.3 Concealed: Pipe shall not run in inaccessible or concealed spaces in or under buildings where its condition cannot be inspected and where undetected leakage might cause dangerous accumulation of gas.

M-624.19.4 Coatings: Underground pipe which is outdoors, buried or otherwise exposed to moisture or corrosive conditions, shall have an outside protective coating.

M-624.19.5 Stresses: Where it is necessary to run piping on outside walls, it shall be protected against excessive stresses due to changes of temperature.

M-624.19.6 Branch outlets: All branch outlet pipes shall be taken from the top or sides of running lines and not from the bottom.

M-624.19.7 Dip-sags: Piping shall be free of dips or sags. See Section M-602.0.

M-624.19.8 Drain: Horizontal pipes shall drain to the riser and from the riser toward the meter or to a drip.

M-624.19.9 Hangers: Piping shall be supported by hangers at proper intervals and protected from mechanical injury.

M-624.19.9.1 Flat iron may be used for hangers or parts of hangers provided that the thickness of metal is at least three-sixteenths ($\frac{3}{16}$) inch and that the hanger or part is of sufficient width to assure metal at the screw holes of approximately equal area to that required for round wrought iron U-type hangers.

M-624.19.9.2 C-type hangers are acceptable for use on steel beams when provided with a strap. Where the steel beam is tilted so that the clamp cannot fall off, the strap may be omitted.

M-624.19.9.3 Where piping is supported from masonry walls, metal expansion plugs shall be used and approved pipe hangers securely fastened to the plugs.

M-624.19.10 Tees: A tee fitting with the bottom outlet plugged or capped shall be used instead of an ell fitting at the bottom of all risers and drops.

M-624.19.11 Pipe compounds: Pipe joint compounds shall be used sparingly and applied to male threads only.

M-624.20 Testing of piping for tightness (natural gas, LPG and LPG-air gas)

M-624.20.1 Cleansing, testing: Before any system of gas piping is put in service, such shall be cleaned and carefully tested to insure gas tightness.

M-624.20.2 Defects: Defects in pipe shall not be repaired other than by welding or by replacing defective pipe. Defective fittings shall be replaced.

M-624.20.3 Fire for testing: Flame or fire in any form shall not be used in attempting to locate a gas leak.

M-624.20.4 Method: Gas piping shall not be filled with water or other liquids to locate or eliminate leaks. Oxygen shall not be used for this purpose. Carbon dioxide nitrogen or other inert gases may be used. A soap and water solution may be applied to the pipe exterior to locate leaks.

M-624.20.5 Open fittings-valves: Before gas is turned on into a system of gas piping, or after being shut off, the entire system shall be checked to make certain that fittings or ends are not open and that all valves at outlets are closed.

M-624.21 Purging of gas piping (natural gas, LPG and LPG-air gas): See Section M-606.0.

M-624.22 Inspection and tests: Responsibility for carrying into effect the following installation requirements, testing and giving operating instructions to the user of the gas boiler shall rest with the qualified boiler contractor making the installation.

M-624.23 Purging, boiler passes

M-624.23.1 General: The boiler-furance and passes shall be thoroughly purged before lighting of pilots and burners after a shut-down and also before relighting after any unscheduled extinguishment of burners. This shall be performed by creating air flow through the setting by operating flue dampers and air inlets and by operation of induced and forced draft fans, if present.

M-624.23.2 **Disconnect:** When a boiler is shut down for an extended period, means shall be provided to prevent gas from leaking into the boiler. This shall be accomplished by blocking off or disconnecting the gas supply pipe.

M-624.24 **Pilot operation (natural gas, LPG and LPG-air gas)**

M-624.24.1 **General:** After the piping has been thoroughly purged, the pilot burner shall be lighted and adjusted and the main burners put into operation in accordance with the manufacturer's instructions.

M-624.24.2 **Pilot failure:** Pilot flames shall not become extinguished:

1. when the main burner or burners are turned off or on in a normal manner, either manually or by automatic control; and
2. when the air flow through the burner is rapidly changed from maximum to minimum or vice versa after the main burners are shut off following operation of boiler at its maximum capacity.

M-624.24.3 **Carbon:** Pilots shall be adjusted so as to not deposit carbon.

M-624.24.4 **Bleed pilots.** Where escapement of bleed pilots are used, their flames shall be freely ignited by the constant burning pilot.

M-624.24.5 **Ignition:** The pilots shall effect immediate ignition of the gas at the main burners, equipped with flame safeguards, even when the gas supply to the pilots is reduced to a point where the flame is just sufficient to actuate or energize the flame-detection device.

M-624.25 **Burner operation (natural gas, LPG and LPG-air gas)**

M-624.25.1 **Flash back:** Burner flames shall not flash back within the operating range of the burner.

M-624.25.1.1 Burner flames shall not flash outside the boiler when the gas is turned on or off.

M-624.25.2 **Main burner:** Main burner gas shall ignite freely from constant burning pilots within the operating range of the burner.

M-624.25.3 **Arrangement:** The arrangement of burners, burner valves and pilots shall be such that when only the pilots are in operation, the gas from any burner, or combination of burners, shall be effectively ignited without delayed ignition or flashback.

M-624.25.4 **Adjustment:** Adjustment shall be made in accordance with the manufacturer's instructions so that the air-gas ratios obtained will complete the combustion in the space provided over the full operating range of the burner.

M-624.26 **Controls (natural gas, LPG and LPG-air gas)**

M-624.26.1 Test: All automatic safety shut-off gas valves shall be tested for gas tightness while in the closed position before being placed in service. They shall be tested periodically thereafter by the user. During the test, gas shall be shut off to all burners downstream from the safety shut-off valve.

M-624.26.2 Proper operation: The flame safeguard equipment and various other controls of the boiler shall be checked to assure their proper operation.

M-624.27 Instruction to the operator: All operating personnel shall be thoroughly instructed as to the proper and safe operation of the boiler and as how to periodically test safety controls before the boiler is placed in continuous service. Suitable instruction, including wiring diagrams, shall be supplied and made conveniently available or posted in a prominent place near the boiler.

M-624.28 Liquid fuel, solid fuel, liquefied petroleum gas and liquefied petroleum air gas: The installation of liquid fuel, solid fuel, or liquefied petroleum gas-fired appliances and their appurtenances shall conform with the requirements as set forth in National Fire Protection Association's Standards Nos. 31, 58, 85, 85B, 85D, and 85E listed in Appendix B.

M-624.29 Chimney or vent connections (liquid and solid fuel, LPG and LPG-air gas): See Article 7.

SECTION M-625.0 MISCELLANEOUS GAS BURNING APPLIANCES

M-625.1 Outdoor gas appliances: All listed or approved outdoor-type appliances, including but not limited to, gas lights, gas grills, radiant heaters and gas-fired incinerators shall be installed in accordance with their listing or approval and the manufacturer's instructions.

M-625.2 General: Gas piping to the appliances and their installation shall meet the requirements of this code, except as otherwise permitted in this section.

M-625.3 Venting: The venting requirements of Article 7 need not apply.

> **Exception:** Outdoor gas-fired incinerators shall be vented in accordance with their approval.

M-625.4 Unlisted appliances: Unlisted outdoor appliances shall be approved prior to use.

M-625.5 Clearances: Appliances shall be installed with clearances from combustible materials as recommended by the manufacturer, except as required in the following sections.

M-625.5.1 Gas lights shall be installed with clearance from combustible materials of at least twelve (12) inches in any direction. Gas lights shall not be installed inside any enclosed structure or under a soffit or similar overhang unless approved by a nationally recognized testing or inspection agency and the department.

M-625.5.2 Gas-fired grills shall be installed with a clearance from combustible materials of at least thirty-six (36) inches to the sides and at least forty-eight (48) inches to the top of the unit.

M-625.5.3 Gas-fired infrared heaters designed as patio heaters shall be installed with a clearance to combustibles of at least eighteen (18) inches to the top of the unit, eighteen (18) inches to the side and five (5) feet measured perpendicular to the plane of the infrared emitting face in the direction of emission.

M-625.6 **Inside buildings:** Outdoor appliances shall not be installed inside any buildings or below the roofed area of any patio or porch having side enclosures greater than fifty (50) per cent of the total possible side enclosure of the area.

M-625.7 **Gas light posts:** Posts shall be rigidly mounted. The strength and rigidity of posts greater than three feet in height shall be at least equivalent to that of a two and one-half (2½) inch diameter post constructed of No. 14 Manufacturers' Standard Gage (0.075 inch) steel or a one (1) inch diameter Schedule 40 steel pipe. Posts three (3) feet or less in height shall not be smaller than a three-quarter (¾) inch diameter Schedule 40 steel pipe.

M-625.7.1 **Post foundation:** Gas lights posts shall be placed at least eighteen (18) inches into the ground and encased in concrete at least fifteen (15) inches deep and two (2) inches on all sides.

M-625.8 **Gas grills, permanently mounted:** The post on permanently installed grills shall be placed at least eighteen (18) inches into the ground and encased in concrete at least fifteen (15) inches deep and two (2) inches on all sides. The post of flangemount-type grills shall be secured to the (concrete slab or equivalent) patio floor. An accessible shut-off valve or gas cock shall be installed adjacent to the appliance.

M-625.9 **Gas grills, portable:** Approved gas hose may be used for connecting portable outdoor grills. The gas hose shall not exceed fifteen (15) feet in length and shall have a gas pressure drop not exceeding three-tenths (0.3) inch water column. The gas hose shall be permanently equipped with an approved quick disconnect coupling of the automatic shut-off type, installed by the hose manufacturer. The coupling will be provided with a means for preventing foreign materials from entering the coupling during disconnected periods. An accessible shut-off valve or gas cock shall be installed adjacent to the quick disconnect coupling. The gas hose and the quick disconnect coupling shall be installed between the shut-off valve and the grill.

M-625.10 **Wood burning fire place log lighters:** Approved log lighters for wood burning fire places shall have a gas input not to exceed thirty thousand (30,000) Btus per hour. The lighter shall be provided with an automatic safety shut-off device which will shut off the main gas supply to the burner in the event of a burner flame failure and be provided with a timing device which will permit gas flow for a period not to exceed one (1) hour. A manual shut-off valve or gas cock shall be installed adjacent to the appliance. Valves and controls shall be accessible.

SECTION M-626.0 UNAUTHORIZED DEVICES

M-626.1 General: Devices purporting to reduce gas consumption by attachment to a gas appliance, to the gas supply line thereto, or the vent outlet or vent piping therefrom shall not be used unless each installation is specifically approved for such use.

SECTION M-627.0 ELECTRICAL WIRING AND CONTROLS

M-627.1 General: Electrical wiring and controls shall conform to the requirements of this code and the electrical code of this jurisdiction.

SECTION M-626.0 SPECIAL EQUIPMENT.

M-628.1 General: Whenever it is necessary to install equipment specifically approved for installation in noncombustible locations on or near combustbile material, such combustible material shall be adequately protected in an approved manner.

M-628.2 Ventilation: Adequate means shall be provided to properly ventilate the room or space in which hotel or restaurant equipment is installed to permit proper combustion of the gas. Whenever exhaust fans are used for ventilation, they shall not interfere with the proper operation of the equipment. For hoods, see Article 3.

ARTICLE 7

CHIMNEYS AND VENTS

SECTION M-700.0 GENERAL

M-700.1 Scope: In addition to the other requirements in this code, this article shall govern the installation, maintenance, repair and approval of all chimneys, vents, and connectors. All commercial or industrial incinerator chimneys or vents shall comply with this article and Article 9.

M-700.2 Requirements: Every chimney shall be constructed and every venting system shall be installed in accordance with the applicable requirements in this article. The type of chimney or vent required to serve the various classifications of appliances shall be as set forth in Tables M-701 and M-716.

M-700.3 Performance test and acceptance criteria: The building official may require a test or tests of any chimney or vent to insure fire safety and the removal of smoke and products of combustion.

M-700.3.1 Acceptance criteria: The system shall be accepted if the following conditions are fulfilled.

1. There shall not be spillage at the draft hood when any one (1) or combination of appliances connected to the system is in operation.
2. Temperature on adjacent combustible surfaces shall not be raised more than the limits acceptable to nationally recognized testing or inspection agencies.
3. Condensation shall not be developed in a way that would cause deterioration of the vent or chimney or drip from joints or bottom end of the vent or chimney.
4. The draft reading taken at the place recommended in the installation instructions shall be within the range specified by the appliance manufacturer.

M-700.3.2 Approved installations: Factory-built chimneys and vents which have been tested and listed by a nationally recognized testing or inspection agency shall be accepted as complying with the requirements of Item 2 of Section M-700.3.1 when installed in accordance with the clearances specified in the listing.

M-700.4 Draft: Every chimney, vent or venting system shall be capable of producing a draft at the appliance not less than that required for the safe operation of the appliance connected thereto.

M-700.4.1 A power exhauster may be used, except with incinerators, to increase insufficient draft (see Article 9 for incinerators).

M-700.4.2 When an exhauster is used, provision shall be made to shut off the fuel supply to the appliance in the event of failure of the exhauster.

M-700.5 Engineered vent system: Special engineered vent system tables may be used in determining vent and vent connector sizes. The vent or vertical portion of the venting system shall not be smaller than the largest vent connector.

M-700.6 Prohibited installations

M-700.6.1 Termination below ceiling: The construction or use of a shelf or bracket-type chimney is prohibited.

M-700.6.2 The use of flue-fed type incinerators is prohibited except as set forth in Article 9.

M-700.7 Breechings: See Article 9 for commercial incinerator breechings (see Section M-718.0 for chimney and vent connectors).

M-700.8 Existing chimneys

M-700.8.1 When an existing chimney is unlined and the chimney indicates flue-gas leakage, an approved liner or another vent shall be installed.

M-700.8.2 When inspection by the department reveals that an existing chimney is not safe for the intended application, such chimney shall be rebuilt, replaced or repaired to conform to the requirements of this article.

M-700.8.3 Existing chimneys (unlined) having not less than four (4) inch nominal brick walls may be used for the venting of domestic gas-fired free standing incinerators when such chimneys meet the other requirements of this section.

700.8.4 Raising existing chimneys: Whenever a building is hereafter erected, enlarged or increased in height so that a wall along an interior lot line, or within three (3) feet thereof, extends above the top of an existing chimney or vent of an adjoining existing building, the owner of the building so erected, enlarged or increased in height shall carry up at his own expense, with the consent of the adjoining property owner, either independently, or in his own building, all chimneys connected to liquid or solid fuel burning appliances. Gas vents within six (6) feet of any portion of the wall of such adjoining building shall be extended two (2) feet above the roof or parapet of the adjoining building.

Table M-701

CHIMNEY SELECTION CHART

Chimneys for residential-type appliances	Chimneys for low-heat appliances		Chimneys for medium-heat appliances[a]	Chimneys for high-heat appliances[c]
	Building heating appliances	Industrial type low-heat appliances		
1. Factory-built. 2. Masonry (residential type).	1. Factory-built. 2. Masonry (low-heat type). 3. Metal (low-heat type).	1. Factory-built (industrial low-heat type). 2. Masonry (low-heat type). 3. Metal (low-heat type).	1. Factory-built (industrial medium-heat type). 2. Masonry (medium-heat type). 3. Metal (medium-heat type).	1. Masonry (high-heat type). 2. Metal (high-heat type).
Types of appliances to be used with each type chimney				
Column I	**Column II**	**Column III**	**Column IV**	**Column V**
A. Residential-type appliances, such as: 1. Ranges. 2. Warm air furnaces. 3. Water heaters 4. Hot water heating boilers. 5. Low pressure steam heating boilers (not over 15 psig). 6. Domestic incinerators. 7. Floor furnaces. 8. Wall furnaces. 9. Room heaters. 10. Fireplace stoves. B. Fireplaces.	A. All appliances shown in Column I. B. Nonresidential-type building heating appliances for heating a total volume of space exceeding 25,000 cubic feet.[d] C. Steam boilers operating at not over 50 psig pressure; pressing machine boilers.	All appliances shown in Columns I and II, and appliances such as: 1. Annealing baths for hard glass (fats, paraffin, salts, or metals). 2. Bake ovens (in bakeries). 3. Boiling vats, for wood fiber, straw, lignin, etc. 4. Candy furnaces. 5. Coffee roasting ovens. 6. Core ovens. 7. Cruller furnaces. 8. Feed drying ovens. 9. Fertilizer drying ovens. 10. Fireplaces, other than residential-type. 11. Forge furnaces (solid fuel). 12. Gypsum kilns. 13. Hardening furnaces (below dark red). 14. Hot air engine furnaces. 15. Ladle drying furnaces. 16. Lead melting furnaces.	All appliances shown in Columns, I, II and III, and appliances such as: 1. Alabaster gypsum kilns. 2. Annealing furnaces (glass or metal). 3. Charcoal furnaces. 4. Cold stirring furnaces. 5. Feed driers (direct fire heated). 6. Fertilizer driers (direct fire heated). 7. Galvanizing furnaces. 8. Gas producers. 9. Hardening furnaces (cherry to pale red). 10. Incinerators, commercial and industrial type. 11. Lehrs and glory holes. 12. Lime kilns. 13. Linseed oil boiling furnaces. 14. Porcelain biscuit kilns. 15. Pulp driers (direct fire heated).	All appliances shown in Columns I, II, III, and IV and appliances[b] such as: 1. Bessemer retorts. 2. Billet and bloom furnaces. 3. Blast furnaces. 4. Bone calcining furnaces. 5. Brass furnaces. 6. Carbon point furnaces. 7. Cement brick and tile kilns. 8. Ceramic kilns. 9. Coal and water gas retorts. 10. Cupolas. 11. Earthenware kilns. 12. Glass blow furnaces. 13. Glass furnaces (smelting). 14. Glass kilns. 15. Open hearth furnaces. 16. Ore roasting furnaces. 17. Porcelain baking and glazing kilns.

Table M-701 (cont'd)
CHIMNEY SELECTION CHART

	Column III	Column IV	Column V
	17. Nickel plate (drying) furnaces. 18. Paraffin furnaces. 19. Recuperative furnaces (spent materials). 20. Rendering furnaces. 21. Restaurant-type cooking appliances using solid or liquid fuel. 22. Rosin melting furnaces. 23. Stereotype furnaces. 24. Sulphur furnaces. 25. Tripoli kilns (clay, coke and gypsum). 26. Type foundry furnaces. 27. Wood drying furnaces. 28. Wood impregnating furnaces. 29. Zinc amalgamating furnaces.	16. Steam boilers operating at over 50 psig pressure except pressing machine boilers. 17. Water-glass kiln. 18. Wood-distilling furnaces. 19. Wood-gas retorts.	18. Pot-arches. 19. Puddling furnaces. 20. Regenerative furnaces. 21. Reverberatory furnaces. 22. Stacks, carburetor or superheating furnaces (in water gas works). 23. Vitreous enameling ovens (ferrous metals). 24. Wood carbonizing furnaces.

Note a. Appliances otherwise classed as high-heat appliances may be considered as medium-heat appliances if not larger than 100 cubic feet in size.

Note b. When such appliances are larger than 100 cubic feet in size, and other furnaces classified as high-heat appliances in accordance with nationally recognized good practice.

Note c. Continuous operating equipment of the counter current type may not require the type of flue indicated by general types of appliances.

Note d. Nonresidential-type building heating appliances for heating a total volume of space not to exceed 25,000 cubic feet may be connected to chimneys for residential-type appliances.

M-700.9 Limited accessibility: In buildings where the existing chimney can only be reached through a crawl space for inspection and cleaning, a new chimney or vent shall be constructed.

M-700.10 Starting level and support: Only vents and factory-built chimneys may start at the desired level. Vents shall be securely anchored to the building so that they cannot be dislodged in any direction. Straps shall be at least No. 26 Galvanized Sheet Gage steel (0.022 inch) and shall be installed at intervals of not more than five (5) feet and at every change in direction.

M-700.11 Offsetting inlets: Where two (2) or more inlets are provided in any vent or chimney, such inlets shall be offset in such a manner that any portion of any inlets shall not be opposite to other inlets.

SECTION M-701.0 TYPES OF CHIMNEYS

M-701.1 Factory-built chimneys: Factory-built chimneys are factory-made, approved, listed chimneys and shall be installed in strict accordance with the terms of their approval and listing and the manufacturer's instructions.

M-701.2 Masonry chimneys: Masonry chimneys shall be field constructed to meet the requirements of Sections M-702.0, M-703.0, M-704.0, M-705.0, M-706.0, M-707.0, M-708.0, and M-709.0.

M-701.3 Metal chimneys: Metal chimneys shall be field constructed to meet the requirements of Sections M-710.0, M-711.0, M-712.0, M-713.0, M-714.0, and M-715.0.

SECTION M-702.0 MASONRY CHIMNEYS, GENERAL REQUIREMENTS

M-702.1 Foundations: Masonry chimneys shall be supported on properly designed foundations of masonry or reinforced concrete or on noncombustible material having a fireresistance rating of not less than three (3) hours, provided such supports are independent of the building construction, and the load is transferred to the ground.

M-702.2 Structural design: Chimneys shall be designed, anchored, supported and reinforced as required in this article. Chimneys shall not support any structural load other than their own weight unless designed to act as supporting members. Chimneys in wood-frame buildings shall be anchored laterally at the ceiling lines and at each floor line which is more than six (6) feet above grade, except when entirely within the framework of the building.

M-702.3 Area: Chimney passageways shall not be smaller in area than the vent connection on the appliance attached thereto, nor less than as set forth in Table M-702 unless alternate approved engineering methods have been used to design the system (see Section M-700.5).

Table M-702
MINIMUM PASSAGE AREAS FOR MASONRY CHIMNEYS

Type of Masonry chimney[a]	Minimum cross-sectional area		
	Round	Square or rectangle	Lined with firebrick or unlined
Residential	50 sq. in	50 sq. in	85 sq. in.
Fireplace[b]	1/12 of opening Minimum 50 sq. in	1/10 of opening Minimum 64 sq. in.	1/8 of opening Minimum 100 sq. in.
Low-heat	50 sq. in	57 sq. in.	135 sq. in.

Note a. Areas for medium- and high-heat chimneys shall be determined using accepted engineering methods and as approved by the department.

Note b. Where fireplaces open on more than one side, the fireplace opening shall be measured along the greatest dimension.

M-702.4 Separation of masonry chimney passageway: When more than one (1) flue passageway is contained in the same chimney, masonry separation at least four (4) inches thick, bonded into the masonry wall of the chimney, shall be provided to separate such passageways.

M-702.5 Corbeling: Masonry chimneys shall not be corbeled from a wall more than six (6) inches nor shall a masonry chimney be corbeled from a wall which is less than twelve (12) inches in thickness, unless it projects equally on each side of the wall. In the second story of a two-story building of one- and two-family occupancy, corbeling of masonry chimneys on the exterior of the enclosing walls may equal the exterior wall thickness. In any case, the corbeling shall not exceed one (1) inch projection for each course of brick.

M-702.6 Change in size or shape: Changes in the size or shape of a masonry chimney, where the chimney passes through the roof, shall not be permitted within a distance of six (6) inches above or below the roof joists or rafters.

M-702.7 Inlets: Every connector inlet to any masonry chimney shall enter the side thereof and shall be of metal not less than No. 24 Manufacturers' Standard Gage (0.024 inch) or five-eighths (⅝) inch thick refractory material (see Section M-718.0 for chimney connectors).

M-702.8 Cleanouts: Every masonry chimney shall be provided with an approved cleanout having a tight-fitting cover. Such cleanouts shall be installed at least twelve (12) inches below the lowest chimney inlet opening.

M-702.9 Firestopping: All spaces between chimneys and floors and ceilings through which chimneys may pass shall be firestopped with noncombustible material. The firestopping of spaces between chimneys and wood joists, beams or headers shall be to a depth of one (1) inch only placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.

M-702.10 Smoke test: Masonry chimneys shall be proved tight by a smoke test after erection and before being put into use.

SECTION M-703.0 MASONRY CHIMNEYS FOR RESIDENTIAL-TYPE APPLIANCES

M-703.1 Construction: Masonry chimneys for residential-type appliances shall be constructed of solid masonry units or reinforced concrete with walls not less than four (4) inches thick or rubble stone masonry not less than twelve (12) inches thick. Masonry shall be laid with full, push-filled cross and bed mortar joints.

M-703.2 Lining: Masonry chimneys for residential-type appliances shall be lined with fire-clay flue lining (ASTM C315), or the equivalent, not less than five-eighths (⅝) of an inch thick, or with liner of other approved material that will resist corrosion, softening or cracking from flue gases at temperatures up to eighteen hundred (1800) degrees F.

M-703.2.1 Fire-clay flue liner shall be installed ahead of the construction of the chimney as it is carried up and carefully bedded one on the other in refractory mortar (ASTM C105, medium duty), or the equivalent, with close fitting joints left smooth on the inside.

M-703.2.2 Liners shall be separate from the chimney wall and the space between the liner and masonry shall not be filled; only enough mortar shall be used to make a good joint and hold the liners in position.

M-703.2.3 Flue liners shall start from a point not less than eight (8) inches below the intake. They shall extend, as nearly vertical as possible, for the entire height of the chimney.

M-703.2.4 Where two (2) adjoining flues in the same chimney are separated only by flue liners, the joints of the adjacent flue liners shall be staggered at least seven (7) inches.

M-703.2.5 Where more than two (2) flues are located in the same chimney, masonry wythes (partitions) at least (4) inches wide and bonded into the masonry walls of the chimney shall be built at such points between adjacent flue linings that there are not more than two (2) flues in any group of adjoining flues without such wythe separation.

M-703.3 Termination (height): Masonry chimneys for residential-type appliances shall extend at least three (3) feet above the highest point where they pass through the roof of a building and at least two (2) feet higher than any portion of a building within ten (10) feet.

M-703.4 Clearance from combustible material

M-703.4.1 All wood beams, joists and studs shall be trimmed away from chimneys. Headers, beams, joists and studs shall not be less than two (2) inches from the outside face of a chimney or from masonry enclosing a flue. Ends of wood girders may be supported on a corbeled shelf of a masonry chimney, provided there is not less than eight (8) inches of solid masonry between the ends and the flue liner.

M-703.4.2 Combustible lathing, furring or plaster grounds shall not be placed against a chimney at any point more than one and one-half (1½) inches from the corner of the chimney, but this shall not prevent plastering directly on the masonry or on metal lath and metal furring, nor shall it prevent placing chimneys for residential-type appliances entirely on the exterior of a building against the sheathing.

SECTION M-704.0 MASONRY CHIMNEYS FOR LOW-HEAT APPLIANCES

M-704.1 Construction: Masonry chimneys for low-heat appliances shall be constructed of solid masonry units or reinforced concrete with walls not less than eight (8) inches thick or rubble stone masonry not less than twelve (12) inches thick. Masonry shall be laid with full, push-filled cross and bed mortar joints.

M-704.2 Lining: Masonry chimneys for low-heat appliances shall be lined with fire-clay flue lining (ASTM C315), or the equivalent, not less than five-eighths (⅝) of an inch thick, or with liner of other approved material that will resist erosion, softening or cracking from flue gases at temperatures up to eighteen hundred (1800) degrees F.

M-704.2.1 Fire-clay flue liners shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in refractory mortar (ASTM C105, medium duty), or the equivalent, with close-fitting joints left smooth on the inside.

M-704.2.2 Flue liners shall start from a point not less than eight (8) inches below the intake. They shall extend, as nearly vertical as possible, for the entire height of the chimney.

M-704.2.3 Where two (2) adjoining flues in the same chimney are separated only by flue liners, the joints of the adjacent flue liners shall be staggered at least seven (7) inches.

M-704.2.4 Where more than two (2) flues are located in the same chimney, masonry wythes (partitions) at least four (4) inches wide and bonded into the masonry walls of the chimney shall be built at such points between adjacent flue linings that there are not more than two (2) flues in any group of adjoining flues without such wythe separation.

M-704.3 Termination (height): Masonry chimneys for low-heat appliances shall extend at least three (3) feet above the highest point where they pass through the roof of a building and at least two (2) feet higher than any portion of a building within ten (10) feet.

M-704.4 Clearance from combustible material

M-704.4.1 All wood beams, joists and studs shall be trimmed away from chimneys. Headers, beams, joists and studs shall not be less than two (2) inches from the outside face of a chimney or from masonry enclosing a flue.

M-704.4.2 Combustible lathing, furring or plaster grounds shall not be placed against a chimney at any point more than one and one-half (1½) inches from the corner of the chimney, but this shall not prevent plastering directly on the masonry or on metal lath and metal furring, nor shall it prevent placing chimneys for low-heat appliances entirely on the exterior of a building against the sheathing.

SECTION M-705.0 MASONRY CHIMNEYS FOR MEDIUM-HEAT APPLIANCES

M-705.1 **Construction:** Masonry chimneys for medium-heat appliances shall be constructed of solid masonry units or of reinforced concrete with walls not less than eight (8) inches thick or with stone masonry not less than twelve (12) inches thick.

M-705.2 **Lining:** Masonry for medium-heat appliance chimneys shall be lined with medium-duty refractory brick (ASTM C64), or the equivalent, not less than four and one-half (4½) inches thick laid on the four and one-half (4½) inch bed in refractory mortar (ASTM C105 medium duty), or the equivalent. The lining shall start two (2) feet or more below the lowest chimney connector entrance and shall extend to a height of at least twenty-five (25) feet above the highest chimney connector entrance. Chimneys terminating twenty-five (25) feet or less above a chimney connector entrance shall be lined to the top.

M-705.3 **Termination (height):** Masonry chimneys for medium heat appliances shall extend not less than ten (10) feet higher than any portion of any building within twenty-five (25) feet.

M-705.4 **Clearance:** A clearance of not less than four (4) inches shall be provided between the exterior surfaces of a masonry chimney for medium-heat appliances and combustible material.

SECTION M-706.0 MASONRY CHIMNEYS FOR HIGH-HEAT APPLIANCES

M-706.1 **Construction:** Masonry chimneys for high-heat appliances shall be constructed with double walls of solid masonry units or reinforced concrete, each wall to be not less than eight (8) inches thick with an air space of not less than two (2) inches between them.

M-706.2 **Lining:** The inside of the interior wall shall be lined with high duty refractory brick (ASTM C64), or the equivalent, not less than four and one-half (4½) inches thick laid on the four and one-half (4½) inch bed in refractory mortar (ASTM C105, high duty), or the equivalent. The lining shall start at the base of the chimney and extend continuously to the top.

M-706.3 Termination (height): Masonry chimneys for high-heat appliances shall extend not less than twenty (20) feet higher than any portion of any building within fifty (50) feet.

M-706.4 Clearance: Masonry chimneys for high-heat appliances shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection and maintenance operations on the chimney and to avoid danger of burns to persons. Clearances shall be based on good engineering practice and acceptable to the authority having jurisdiction.

SECTION M-707.0 MASONRY CHIMNEYS FOR RESIDENTIAL-TYPE INCINERATORS

M-707.1 General: Masonry chimneys for residential-type incinerators shall be constructed in accordance with the requirements for chimneys for residential-type appliances (see Section M-703.0).

SECTION M-706.0 MASONRY CHIMNEYS FOR CHUTE-FED AND FLUE-FED INCINERATORS: See Article 9.

SECTION M-709.0 MASONRY CHIMNEYS FOR COMMERCIAL AND INDUSTRIAL-TYPE INCINERATORS

M-709.1 Construction: Masonry chimneys for commercial and industrial incinerators shall be constructed of solid masonry units or reinforced concrete with walls not less than eight (8) inches thick. Chimneys may be supported on incinerator walls if the incinerator foundation and walls are built to support the load thus imposed. They shall be so constructed as not to place excessive stress upon the roof of the combustion chamber.

M-709.2 Lining: Masonry chimneys for commercial and industrial incinerators shall be lined with medium duty refractory brick (ASTM C64), or the equivalent not less than four and one-half (4½) inches thick laid on the four and one-half (4½) inch bed in refractory mortar (ASTM C105, medium duty), or the equivalent. The lining shall start at the base of the chimney and extend continuously to the top.

M-709.3 Termination (height): Masonry chimneys for commercial and industrial incinerators shall extend at least four (4) feet above sloping roofs measured from the highest point at which the chimney passes through the roof and at least eight (8) feet above flat roofs. In either case, the chimney shall extend at least two (2) feet above any portion of a building within twenty (20) feet.

M-709.4 Clearance: A clearance of not less than four (4) inches shall be provided between the exterior surface of masonry chimneys for commercial and industrial-type incinerators and combustible materials.

M-709.5 Spark arrestor: All commercial and industrial incinerator chimneys shall terminate in a substantially constructed spark arrestor of not less than No. 10 Steel Wire Gage (0.135 inch) mesh meeting the following requirements set forth in Sections M-709.5.1 through M-709.5.5.

M-709.5.1 The net free area of the arrestor shall be not less than four (4) times the net free area of the outlet of the chimney flue it serves.

M-709.5.2 Arrestors shall have a vertical height of not less than one and three-tenths (1.3) times the minimum horizontal dimension of the chimney flue.

M-709.5.3 Arrestors, including bolts, rivets, screws and supporting members, shall be made of stainless steel (ASTM A167, Type 316 or ASTM A478, Type 316), or the equivalent.

M-709.5.4 Openings shall not permit the passage of spheres having a diameter larger than one-half (½) inch nor block the passage of spheres having a diameter of less than three-eighths (⅜) inch.

M-709.5.5 Means shall be provided for securely attaching the spark arrestors to chimneys to provide adequate support and prevent movement of the arrestor.

SECTION M-710.0 METAL CHIMNEYS (SMOKESTACKS), GENERAL REQUIREMENTS

M-710.1 Prohibited installation

M-710.1.1 Single wall: Single wall metal chimneys shall not be used in one- and two-family dwellings.

M-710.1.2 Metal chimneys shall not be carried up inside of ventilating ducts unless such ducts are constructed and installed as required by this article for chimneys, and the ventilating ducts are used solely for exhaust of air from the room or space in which the appliance served by the metal chimney is located.

M-710.2 Minimum thickness: Metal chimneys shall be listed or have the minimum thickness indicated in Table M-710.2 and shall be designed

Table M-710.2

METAL CHIMNEY MINIMUM THICKNESS

Mfrs. Std. Gage No.		Area (sq. in.)
Inch thick	Gage	
0.060 in.	16	Up to 154
0.075 in.	14	154 to 201
0.105 in.	12	201 to 254
0.135 in.	10	Larger than 254

and constructed as specified in this article (see Section M-718.0 for chimney connectors).

M-710.3 Unlisted chimneys: Unlisted metal chimneys shall be riveted or welded and, unless structurally self-supporting, shall be guyed securely or firmly anchored to, or otherwise supported by, the building or structure served thereby.

M-710.4 Clearance: Metal chimneys shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection and maintenance operations on the chimney and to avoid danger of burns to persons.

M-710.5 Support: Metal chimneys shall be supported on properly designed foundations of masonry or reinforced concrete or on noncombustible material having a fireresistance rating of not less than three (3) hours, provided such supports are independent of the building construction, and the load is transferred to the ground.

M-710.6 Cleanouts: Cleanout openings shall be provided at the base of every metal chimney.

SECTION M-711.0 METAL CHIMNEYS FOR RESIDENTIAL-TYPE OR LOW-HEAT APPLIANCES

M-711.1 Termination (height)

M-711.1.1 Metal chimneys for residential-type or low-heat appliances, except as provided in Section M-711.2.1, shall extend at least three (3) feet above the highest point where they pass through the roof of a building and at least two (2) feet higher than any portion of a building within ten (10) feet.

M-711.1.2 The outlet of a metal chimney for residential-type and low-heat appliances equipped with an exhauster may terminate at a location not less than three (3) feet from an adjacent building or building opening and at least ten (10) feet above grade or walkways. In any case, the outlet shall be so arranged that the flue gases are not directed so as to jeopardize people, overheat combustible structures or enter building openings in the vicinity of the outlet.

M-711.2 Clearances, exterior

M-711.2.1 Exterior metal chimneys used only for residential-type or low-heat appliances, as defined in Table M-701, shall have a clearance of not less than six (6) inches from a wall of wood frame construction and from any combustible material.

M-711.2.2 Exterior metal chimneys over eighteen (18) inches in diameter shall have a clearance of not less than four (4) inches, and those eighteen (18) inches or less in diameter shall have a clearance of not less than two (2) inches from a building wall of other than wood frame construction.

M-711.2.3 An exterior metal chimney shall not be nearer than twenty-four (24) inches to any door or window or to any walk-way, unless insulated or shielded in an approved manner to avoid burning a person who might touch the chimney.

M-711.3 Clearances, interior

M-711.3.1 Where a metal chimney extends through any story of a building above that in which the appliances connected to the chimney are installed, it shall be enclosed in such upper stories within a continuous enclosure constructed of noncombustible materials and extending from the ceiling of the appliance room to or through the roof so as to maintain the integrity of the fire separations required by the applicable building code provisions. The enclosure walls shall have a fireresistance rating of not less than one (1) hour if the building is less than four (4) stories in height, and not less than two (2) hours if the building is four (4) stories or more in height.

M-711.3.2 The enclosure shall provide a space on all sides of the chimney sufficient to permit inspection and repair, but it shall not be less than twelve (12) inches.

M-711.3.3 The enclosing walls shall be without openings except doorways equipped with approved self-closing fire doors at various floor levels for inspection purposes.

M-711.3.4 Where a metal chimney used for residential-type or low-heat appliances, as defined in Table M-701, is located in the same story of a building as that in which the appliances connected thereto are located, it shall have a clearance of not less than eighteen (18) inches from a wall of wood frame construction and from any combustible material. Such interior metal chimneys over eighteen (18) inches in diameter shall have a clearance of not less than four (4) inches, and those eighteen (18) inches or less in diameter shall have a clearance of not less than two (2) inches from a building wall of other than wood frame construction.

M-711.3.5 Where a metal chimney serving only residential-type or low-heat appliances, as defined in Table M-701, passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of galvanized iron or approved corrosion-resistant metal, extending not less than nine (9) inches below and nine (9) inches above the roof construction, and of a size to provide not less than six (6) inches clearances on all sides of the chimney, or the combustible material in the roof construction shall be cut away so as to provide not less than eighteen (18) inches clearance on all sides of the chimney with the opening closed up with noncombustible material.

SECTION M-712.0 METAL CHIMNEYS FOR MEDIUM-HEAT APPLIANCES

M-712.1 **Lining:** Metal chimneys for medium-heat appliances, as defined in Table M-701, and producing flue gases having a temperature above one thousand (1,000) degrees F., measured at the entrance to the chimney, shall be lined with medium duty refractory brick (ASTM C64), or the equivalent, laid in fire clay mortar (ASTM C105, medium duty), or the equivalent. The lining thickness shall be at least two and one-half (2½) inches for chimneys whose greatest cross-sectional dimension is eighteen (18) inches or less; the lining thickness shall be not less than four and one-half (4½) inches laid on the four and one-half (4½) inch bed for chimneys whose greatest cross-sectional dimension is more than eighteen (18) inches. The lining shall start two (2) feet or more below the lowest chimney connector entrance and shall extend to a height of at least twenty-five (25) feet above the highest chimney connector entrance. Chimneys terminating twenty-five (25) feet or less above the highest chimney connector entrance shall be lined to the top.

M-712.2 **Termination (height):** Metal chimneys for medium-heat appliances shall extend not less than ten (10) feet higher than any portion of any building within twenty-five (25) feet.

M-712.3 **Clearances, exterior**

M-712.3.1 Exterior metal chimneys used for medium-heat appliances, as defined in Table M-701, shall have a clearance of not less than twenty-four (24) inches from a wall of wood frame construction and from any combustible material.

M-712.3.2 Exterior metal chimneys over eighteen (18) inches in diameter shall have a clearance of not less than four (4) inches, and those eighteen (18) inches or less in diameter shall have a clearance of not less than two (2) inches from a building wall of other than wood frame construction.

M-712.3.3 Any portion of an exterior metal chimney shall not be nearer than twenty-four (24) inches to any door or window or to any walk-way, unless insulated or shielded in an approved manner to avoid burning a person who might touch the chimney.

M-712.4 **Clearances, interior**

M-712.4.1 Where a metal chimney extends through any story of a building above that in which the appliances connected to the chimney are installed, it shall be enclosed in such upper stories within a continuous enclosure constructed of noncombustible materials, and extending from the ceiling of the appliance room to or through the roof so as to maintain the integrity of the fire separations required by the applicable building code provisions. The enclosure walls shall have a fireresistance rating of not less than one (1) hour if the building is less than four (4) stories in height and not less than two (2) hours if the building is four (4) stories or more in height.

M-712.4.2 The enclosing walls shall provide a space on all sides of the chimney to permit inspection and repair, but it shall not be less than twelve (12) inches.

M-712.4.3 Where a metal chimney serving a medium-heat appliance, as defined in Table M-701, passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of galvanized iron or approved corrosion-resistant metal, extending not less than nine (9) inches below and nine (9) inches above the roof construction and of a size to provide not less than eighteen (18) inches clearance on all sides of the chimney.

M-712.4.4 Where a metal chimney used for medium-heat appliances, as defined in Table M-701, is located in the same story of a building as that in which the connected appliances are located, it shall have a clearance of not less than thirty-six (36) inches from a wall of wood frame construction and from any combustible material. Such interior metal chimneys over eighteen (18) inches in diameter shall have a clearance of not less than four (4) inches, and those eighteen (18) inches or less in diameter shall have a clearance of not less than two (2) inches from a building wall of other than wood frame construction.

SECTION M-713.0 METAL CHIMNEYS FOR HIGH-HEAT APPLIANCES

M-713.1 **Lining:** Metal chimneys for high-heat appliances, as defined in Table M-701, shall be lined with high duty refractory brick (ASTM C64), or the equivalent, not less than four and one-half (4½) inches thick laid on the four and one-half (4½) inch bed in refractory mortar (ASTM C105, high duty), or the equivalent. The lining shall start two (2) feet or more below the lowest chimney connector entrance and shall extend to a height of at least twenty-five (25) feet above the highest chimney connector entrance. Chimneys terminating twenty-five (25) feet or less above the highest chimney connector entrance shall be lined to the top.

M-713.2 **Termination (height):** Metal chimneys for high-heat appliances shall extend not less than twenty (20) feet higher than any portion of any building within fifty (50) feet.

M-713.3 **Clearance:** Metal chimneys for high-heat appliances shall have sufficient clearance from buildings and structures to avoid overheating combustible material, to permit inspection and maintenance operations on the chimney and to avoid danger of burns to persons. Clearances shall be based on good engineering practice acceptable to the authority having jurisdiction.

SECTION M-714.0 METAL CHIMNEYS FOR RESIDENTIAL-TYPE INCINERATORS

M-714.1 **Construction:** Galvanized steel pipe not less than No. 20 Galvanized Sheet Gage (0.040 inch) or other equivalent noncombustible, fire- and corrosion-resistant material may be used for residential-type incinerators installed in locations such as open sheds, breezeways or carports.

M-714.2 Termination: The pipe shall extend at least three (3) feet above the highest point where it passes by, or through, a roof and at least two (2) feet higher than any portion of a building within ten (10) feet.

M-714.3 Clearance

M-714.3.1 The galvanized steel pipe shall be exposed and readily examinable for its full length with a clearance of not less than eighteen (18) inches maintained from combustible material.

M-714.3.2 Where the pipe passes through a roof constructed of combustible material, it shall be guarded by a ventilating thimble of galvanized steel or approved corrosion-resistant noncombustible material extending not less than nine (9) inches below and nine (9) inches above the roof construction and of a size to provide not less than six (6) inches clearance on all sides of the pipe, or the combustible material in the roof construction shall be cut away so as to provide not less than eighteen (18) inch clearance on all sides of the pipe with noncombustible material used to close the opening.

SECTION M-715.0 METAL CHIMNEYS FOR COMMERCIAL AND INDUSTRIAL-TYPE INCINERATORS

M-715.1 Lining: Metal chimneys for commercial and industrial-type incinerators shall be lined with medium duty refractory brick (ASTM C64), or the equivalent, not less than four and one-half (4½) inches thick laid on the four and one-half (4½) inch bed in refractory mortar (ASTM C105, medium duty), or the equivalent. The lining shall start at the base of the chimney and extend continuously to the top.

M-715.2 Termination (height): Metal chimneys of commercial and industrial-type incinerators shall extend at least four (4) feet above sloping roofs, measured from the highest point at which the metal chimney passes through the roof and at least eight (8) feet above flat roofs. In either case, the chimney shall extend at least two (2) feet higher than any portion of a building within twenty (20) feet.

M-715.3 Clearance: Metal chimneys for commercial and industrial-

Table M-715.1

INSULATING CASTABLE LINING FOR METAL STACKS FOR INCINERATORS

Stack diameter	Lining thickness
12 thru 14"	2"
15 thru 20"	2½"
21 thru 30"	3"
Over 30"	4"

type incinerators shall be installed to provide clearances as specified in Section M-712.0 for metal chimneys for medium-heat appliances.

SECTION M-716.0 VENTING SYSTEMS

M-716.1 Type B gas vents: Type B gas vents shall be used only with listed gas appliances with draft hoods, but shall not be used for venting the following:

1. incinerators;
2. appliances which may be converted readily to the use of solid or liquid fuels;
3. combination gas-oil burning appliances;
4. appliances listed for use with chimneys only; and
5. any appliance which produces flue products in excess of five hundred fifty (550) degrees F. at the inlet of the divertor or draft regulator.

Table M-716

VENTING SYSTEM SELECTION CHART
(TYPE OF VENTING SYSTEM)

I	II	III	IV
Type B Gas Round	Type BW Gas	Type L	Metal Pipe
All listed gas appliances with draft hoods such as: 1. Central furnaces 2. Floor furnaces 3. Heating boilers 4. Ranges and ovens 5. Recessed wall furnaces (above wall section) 6. Room and unit heaters 7. Water heaters 8. Duct-type heater 9. Unit heater 10. Horizontal furnace	1. Recessed wall furnaces 2. Vented wall furnace listed for use with Type BW vents only	1. Low temperature flue gas appliances listed for use with Type L venting systems 2. Gas appliances shown in Column I	(Single wall) 1. Exterior domestic incinerator installations only 2. Residential and low-heat appliances 3. Gas appliances shown in Column I

M-716.2 Type BW gas vents: Type BW vents shall be used only with vented recessed gas wall furnaces listed for use with such vents.

M-716.3 Type L venting system: Type L venting system, consisting of listed vent piping and fittings, shall be used only with gas or oil-burning appliances which are listed for use with a Type L venting system.

SECTION M-717.0 INSTALLATION REQUIREMENTS FOR VENTS

M-717.1 Termination (height): Each vent shall extend above the roof surface through its flashing and shall terminate in an approved cap with a venting capacity at least that of the vent. The caps shall be installed in accordance with the terms of their respective approval and the manufacturer's instructions. When permitted, the outlet of single wall metal pipe used to vent appliances shall terminate at least twenty-four (24) inches from any portion of the building and at least ten (10) feet from any of that portion of the building or structure which extends at an angle of more than forty-five (45) degrees upward from the horizontal. Gravity vents shall terminate not less than twelve (12) inches from any opening through which combustion products could enter a building. Natural draft vents extending through outside walls shall not terminate below eaves adjacent to such walls or parapets.

M-717.1.1 Gravity operated vents shall not terminate less than five (5) feet in vertical height above the lower skirt of the draft hood of the highest connected appliance.

M-717.1.2 Venting system exhausters may be used in lieu of natural draft vents for any gas appliance, except incinerators (see Article 9 for incinerators). When exhausters are used with gas appliances requiring venting, provisions shall be made to prevent the flow of gas to the main burner in the event of failure of the exhaust system. Vent connectors serving gas appliances vented by natural draft shall not be connected into the discharge side of power exhausters. The exit terminals of exhauster-equipped gas venting systems shall be located at least four (4) feet from any building opening and not less than two (2) feet from an adjacent building, and not less than seven (7) feet above grade when located adjacent to public walkways. Forced draft systems, and all portions of induced draft systems under positive pressure during operation, shall be designed and installed so as to be gas-tight or as to prevent leakage of combustion products into a building.

M-717.1.3 A Type BW gas vent or combination of Type BW and Type B shall terminate at an elevation of at least twelve (12) feet above the bottom of the wall furnace being served.

M-717.2 Clearances: All vents shall be installed with clearances to combustibles as specified in this section or in accordance with individual listings.

M-717.2.1 Single wall metal pipe may be used as a gas vent only if it is installed with minimum clearances from combustible materials as follows:

1. appliances without draft hoods, eighteen (18) inches;
2. boilers and furnaces equipped with listed conversion burners and draft hood, nine (9) inches; and
3. listed appliances with draft hoods, except incinerators, six (6) inches.

Exception: Outside uninsulated single wall pipe is not recommended for use in cold climates for venting appliances equipped with draft hoods because temperature differentials may cause condensation corrosion in such pipe.

M-717.2.2 Metal pipe vent passing through an exterior wall constructed of combustible material shall be guarded at the point of passage by a ventilating metal thimble not smaller than indicated below.

1. For listed gas-burning appliances with draft hoods, except incinerators, four (4) inches larger in diameter than the vent pipe, unless there is a run of not less than six (6) feet of vent pipe in the open, between the draft hood outlet and the thimble, in which case the thimble may be two (2) inches larger in diameter than the vent pipe.
2. For incinerators and appliances without draft hoods, twelve (12) inches larger in diameter than the vent pipe.

M-717.2.3. Single wall metal pipe shall be constructed of sheet copper not less than No. 24 B&S gage, galvanized sheet steel not less than No. 20 Galvanized Sheet Gage (0.040 inch) or other approved noncombustible corrosion-resistant material.

M-717.2.4 Metal pipe vent passing through a roof constructed of combustible material shall be guarded at the point of passage as specified for exterior walls in Section M-717.2.2 or by metal thimbles not less than four (4) inches larger in diameter than the pipe with the annular space filled with mineral wool or other approved noncombustible insulating material.

M-717.3 **Protection:** Provisions shall be made to prevent mechanical injury to vents where such extend through walls, floors or roofs.

M-717.4 **Support:** All portions of vents and chimneys shall be properly supported for their weight and design. Listed vents and factory-built chimneys shall be supported and spaced in accordance with their listings and the manufacturer's instructions.

M-717.5 **Size:** Every gravity vent shall be of a size not less than that of the draft hood collar on the appliance attached thereto. The area shall not be less than the area of three (3) inch diameter pipe. When more than one (1) appliance connects to a vent, the vent area shall not be less than the area of the largest vent connector plus fifty (50) per cent of the areas of the additional vent connectors.

> **Exception:** The size of gravity vents and their connectors shall not govern where approved engineering methods have been used to design the venting system.

M-717.6 Vent offsets: Unless part of an engineered venting system, vents shall not have more than two (2) offsets of not more than forty-five (45) degrees from the vertical, provided that if such offset is more than three (3) feet in length it shall be supported for the weight and design to maintain proper clearances, to prevent physical damage and to prevent separation of the joints.

M-717.6.1 When approved, a vent may have one (1) offset of not more than sixty (60) degrees from the vertical, and, if more than three (3) feet in length, shall be supported for the weight and design to maintain proper clearances, to prevent physical damage and to prevent separation of the joints.

M-717.6.2 Any angle greater than forty-five (45) degrees from the vertical is considered horizontal. The total horizontal run of a vent, plus the horizontal vent connection, shall not be greater than seventy-five (75) per cent of the vertical height of the vent. The total horizontal length shall not be greater than fifteen (15) feet.

SECTION M-718.0 CHIMNEY CONNECTORS AND VENT CONNECTORS

M-718.1 Materials: Chimney and vent connectors shall be constructed of one of the following methods described in the following Sections M-718.1.1 through M-718.1.3.

M-718.1.1 Single wall metal pipe, used as a chimney connector, shall be constructed of not less than the following gage galvanized metal specifications in Table M-718.1.1.

M-718.1.2 Vent connectors serving listed gas appliances with draft

Table M-718.1.1

MINIMUM CHIMNEY CONNECTOR GAGES

Diameter of connector	Galvanized Sheet Gage No.	
	Inch thickness	Gage
Less than 6″	0.022 in.	26
6″ to less than 10″	0.028 in.	24
10″ to 12″	0.034 in.	22
13″ to 16″	0.040 in.	20
Greater than 16″	0.064 in.	16

hoods may be constructed of Type B or Type L vent materials, or if sufficient clearance is available and the above is not required, single wall metal pipe may be used, provided such meets the limitations of use and clearances specified in this article.

M-718.1.3 Vent connectors constructed of single wall metal pipe serving gas appliances with draft hoods shall be constructed of not less than the following gage galvanized metal specifications in Table M-718.1.3.

Table M-718.1.3

MINIMUM VENT CONNECTOR GAGES

Diameter of connector	Galvanized Sheet Gage No.	
	Inch thickness	Gage
1″ to 5″	0.019 in.	28
6″ to 9″	0.022 in.	26
10″ or over	0.028 in.	24

M-718.2 Installation

M-718.2.1 Interconnections: Two (2) or more vent or chimney connectors shall not be jointed unless the common connector, the manifold and the vent or chimney are properly sized to serve the appliances connected thereto, and adequate draft is available to remove all products of combustion to the outdoors. Gas and oil appliances, so connected, shall be equipped with primary safety controls. Connectors serving gravity vent-type appliances shall not be connected to a chimney, vent or venting system served by a power exhauster, unless the connection is made on the negative pressure side of the power exhausted.

M-718.2.2 Clearance: Single wall metal connectors shall be installed with clearance to combustibles as indicated in Table M-718.2. These clearances may be reduced if the combustible material is protected in accordance with Table M-718.2.2.

M-718.2.3 Size: The connector for its entire length shall not be smaller than the flue collar of the appliance, unless a part of an engineered venting system or unless otherwise recommended by the appliance, chimney or vent manufacturer or approved by the department.

M-718.2.4 Location: When the connector used for a gas appliance having a draft hood is located in, or passes through, an attic, crawl space or other cold area, that portion of the connector shall be of listed Type B vent material.

M-718.2.5 Length: A connector shall be as short and straight as pos-

Table M-718.2

CHIMNEY CONNECTOR AND VENT CONNECTOR CLEARANCES FROM COMBUSTIBLE MATERIALS

Description of appliance	Minimum clearance, inches (See Note a)
Residential type appliances	
Single wall metal pipe connectors	
Gas appliances without draft hoods	18
Electric, gas and oil incinerators	18
Oil and solid-fuel appliances	18
Unlisted gas appliances with draft hoods	9
Boilers and furnaces equipped with listed gas burners and with draft hoods	9
Oil appliances listed as suitable for use with Type L venting systems, but only when connected to chimneys	9
Listed gas appliances with draft hoods (See Note c)	6
Type L venting system piping connectors	
Gas appliances without draft hoods	9
Electric, gas and oil incinerators	9
Oil and solid-fuel appliances	9
Unlisted gas appliances with draft hoods	6
Boilers and furnaces equipped with listed gas burners and with draft hoods	6
Oil appliances listed as suitable for use with Type L venting systems	(See Note b)
Listed gas appliances with draft hoods	(See Note c)
Type B gas vent piping connectors	
Listed gas appliances with draft hoods	(See Note c)
Commercial-industrial type appliances	
Low-heat appliances	
Single wall metal pipe connectors	
Gas, oil, and solid-fuel boilers, furnaces and water heaters	18
Ranges, restaurant type	18
Oil unit heaters	18
Unlisted gas unit heaters	18
Listed gas unit heaters with draft hoods	6
Other low-heat industrial appliances	18
Medium-heat appliances	
Single-wall metal pipe connectors	
All gas, oil, and solid-fuel appliances	36

Note a. These clearances apply except if the listing of an appliance specifies different clearance, in which case the listed clearance takes precedence.

Note b. If listed Type L venting system piping is used, the clearance may be in accordance with the venting system listing.

Note c. If listed Type B or Type L venting system piping is used, the clearance may be in accordance with the venting system listing.

The clearances from connectors to combustible materials may be reduced if the combustible material is properly protected in accordance with Table M-718.2.2.

Table M-718.2.2

REDUCED CLEARANCES, INCHES WITH SPECIFIC FORMS OF PROTECTION[a]

Type of protection. Applied to the combustible material and covering all surfaces within the distance specified as the required clearance without protection. Thicknesses are minimum.	Where the required clearance without protection is:			
	36 inches	18 inches	9 inches	6 inches
(a) ¼ in. asbestos millboard spaced out 1 in.[b]	30	12	6	3
(b) No. 28 Manufacturers' Standard Gage (0.015 inch) sheet metal on ¼ in. asbestos millboard	24	12	4	2
(c) No. 28 Manufacturers' Standard Gage (0.015 inch) sheet metal spaced out 1 in.[b]	18	9	4	2
(d) No. 28 Manufacturers' Standard Gage (0.015 inch) sheet metal on ⅛ in. asbestos millboard spaced out 1 in.[b]	18	9	4	2
(e) ¼ in. asbestos millboard on 1 in. mineral wool bats reinforced with wire mesh or equivalent	18	6	4	2
(f) No. 22 Manufacturers' Standard Gage (0.015 inch) sheet metal on 1 in. mineral wool bats reinforced with wire or equivalent ...	12	3	2	2

Note a. All clearances shall be measured from the outer surface of the connector to the combustible material, disregarding any intervening protection applied to the combustible material, but the clearance shall not be such as to interfere with the requirements for accessibility.

Note b. Spacers shall be noncombustible material.

sible. The appliance shall be located as close as practicable to the chimney, gas vent or venting system. The horizontal run of an uninsulated connector to a natural-draft chimney, or vent, serving a single liquid or solid fuel-burning appliance shall not be more than seventy-five (75) per cent of the height of the vertical portion of the chimney or vent above the connector, unless part of an engineered venting system. The horizontal run of an insulated connector to a natural draft chimney, or vent, serving a single gas fuel-fired appliance shall not be more than one hundred (100) per cent of the height of the vertical portion of the chimney, or vent, above the connector, unless part of an engineered venting system. The horizontal length, design, and construction of combined connectors, or connector to a manifold joining two (2) or more appliances to a chimney or vent, shall be determined in accordance with approved engineering methods.

M-718.2.6 Pitch: Chimney or vent connectors shall have a rise of at least one-fourth (¼) inch to the foot of run.

M-718.2.7 Support: Vent connectors shall be securely supported for the weight and design to maintain proper clearances, to prevent physical damage and to prevent separation of the joints.

M-718.2.8 Passage through walls: Connectors for listed gas appliances with draft hoods (other than incinerators) may pass through walls or partitions constructed of combustible material if made of listed Type B or Type L material and installed in accordance with their listing. Connectors shall be exposed to view throughout their length. **Connectors serving low-, medium- or high-heat appliances, as classified in Table M-701, shall not pass through interior walls or partitions but shall be located in the same space as the appliance and shall be visible throughout their entire length.**

M-718.2.9 Flow resistance: Connectors shall be installed so as to avoid sharp turns or other construction features which would create excessive resistance to the flow of combustion gases. Devices which will obstruct the free flow of combustion gases shall not be installed in a connector, chimney or vent. This shall not be construed to prohibit the use of devices specifically listed for installation in a connector such as draft regulators and safety controls.

M-718.2.10 Joints: Chimney and vent connectors shall be securely supported and joints fastened with sheet metal screws, rivets or other approved means.

M-718.2.11 Connection: A connector to a masonry chimney shall extend through the wall to the inner face of liner, but not beyond, and shall be firmly cemented to masonry. A thimble shall be used to facilitate removal of the connector for cleaning, in which case the thimble shall be permanently cemented in place with high-temperature cement (see Section M-702.7). Connectors shall not pass through any floor or ceiling. Chimneys or vents shall not have connector openings in more than one (1) story of a building, unless specifically designed for multi-story installations in accordance with Section M-700.5, and provisions are made for completely closing such openings with devices made of noncombustible materials whenever their use is discontinued temporarily.

M-718.2.12 Fireplaces: A connector shall not be connected to a chimney serving a fireplace, unless the fireplace opening or the chimney which vents the fireplace is permanently sealed below the connection.

M-718.2.13 Dampers: Manually operated dampers shall not be placed in chimneys, vents or chimney or vent connectors of liquid- or gas-burning appliances. Fixed baffles on the appliance side of draft hoods and draft regulators shall not be classified as dampers. Automatically operated dampers shall be of approved type designed to maintain a safe damper opening at all times and arranged to prevent firing of the burner unless the damper is opened to a safe position.

M-718.2.14 Draft regulators: A draft regulator shall be installed in the connector serving a liquid fuel-burning appliance unless the appliance is approved for use without such. A draft regulator may be installed in the connector serving a listed gas incinerator when recommended by the incinerator manufacturer. Such draft regulators shall be installed in accordance with the installation instructions accompanying the incinerator. A draft regulator furnished as part of a listed gas appliance shall be installed in the connector serving the appliance. A draft regulator when used shall be installed in the same room or enclosure as the appliance in such a manner that a difference in pressure between air in the vicinity of the regulator and the combustion air supply will not be permitted.

SECTION M-719.0 SPECIAL VENTING ARRANGEMENTS

M-719.1 General: Listed appliances having sealed combustion chambers and which are so constructed and installed that all air for combustion is derived from outside the building and all flue gases are discharged to the outside atmosphere shall be considered as properly vented when installed in accordance with their listing and manufacturer's instructions. Venting requirements as set forth in this article need not apply, except as provided for in Articles 3 and 6.

ARTICLE 8

MECHANICAL REFRIGERATION

SECTION M-800.0 SCOPE AND PURPOSE

M-800.1 Scope: The application of this article is intended to assure the safe design, construction, installation, operation and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle when employed under the occupancy classifications listed in Section M-802.0. The provisions of this article are not intended to apply to the use of water or air as a refrigerant, nor to gas bulk storage tanks that are not permanently connected to a refrigeration system, nor to refrigerating systems installed on railroad cars, motor vehicles, motor drawn vehicles or on shipboard.

M-800.2 Purpose: This article is intended to establish minimum requirements to safeguard life, limb, health and property, to define certain practices which are inconsistent with safety and to prescribe safety practices which will properly provide for future progress and developments in refrigerating systems.

M-800.3 Application: This article shall apply to refrigerating systems installed subsequent to adoption, and to existing systems, or to parts replaced, or added to, prior to or subsequent to adoption. In cases of practical difficulty or unnecessary hardship, the authority having jurisdiction may grant exceptions from the literal requirements of this code or permit the use of other devices or methods, but only when it is clearly evident that equivalent protection is secured.

M-800.4 Listed equipment: Equipment listed by a nationally recognized testing or inspection agency is deemed to meet the design, manufacture and factory test requirements of this code for the refrigerant or refrigerants for which such equipment is designed. Listed and approved refrigerating systems are not required to be field tested to comply with this code.

SECTION M-801.0 DEFINITIONS

Absorber (adsorber): That part of the low side of an absorption system used for absorbing (adsorbing) vapor refrigerant.

Absorption (adsorption) system: A refrigerating system in which the gas evolved in the evaporator is taken up by an absorber (adsorber).

Companion or block valves: Pairs of mating stop valves, valving-off sections of systems and arranged so that these sections may be joined before opening these valves or separated after closing them.

Compressor: A specific machine, with or without accessories, for compressing a given refrigerant vapor.

Compressor unit: A condensing unit less the condenser and liquid receiver.

Condenser: That part of the system designed to liquefy refrigerant vapor by removal of heat.

Condenser coil: A condenser constructed of pipe or tubing other than a shell and tube or shell and coil type.

Condensing unit: A specific refrigerating machine combination for a given refrigerant, consisting of one (1) or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

Container: A cylinder for the transportation of refrigerant (see Section M-812.3).

Critical pressure, critical temperature and critical volume: The terms given to the state points of a substance at which liquid and vapor have identical properties. Above the critical pressure or critical temperature, there is not a line of demarcation between liquid and gaseous phases.

Direct system: See Section M-803.2.

Double direct system: See Section M-803.3.

Double indirect vented open-spray system: See Section M-803.4.4.

Evaporator: That part of the system designed to vaporize liquid refrigerant to produce refrigeration.

Evaporator coil: An evaporator constructed of pipe or tubing other than a shell and tube or shell and coil type.

Field test: A test performed in the field to prove system tightness.

Generator: A device equipped with a means of heating used in an absorption system to drive refrigerant out of solution.

High side: The parts of a refrigerating system subjected to condenser pressure.

Indirect closed-surface system: See Section M-803.4.2.

Indirect open-spray system: See Section M-803.4.1.

Indirect system: See Section M-803.4.

Indirect vented closed-surface system: See Section M-803.4.3.

Internal gross volume: The volume as determined from internal dimensions of the container without allowance for volume of internal parts.

Limited charge system: A system in which, with the compressor idle, the internal volume and total refrigerant charge are such that the design pressure will not be exceeded by complete evaporation of the refrigerant charge.

Liquid receiver: A vessel permanently connected to a system by inlet and outlet pipes for storage of a liquid refrigerant.

Low side: The parts of a refrigerating system subject to evaporator pressure.

Machinery: The refrigerating equipment forming a part of the refrigerating system including any or all of the following: compressor, condenser, generator, absorber (adsorber), liquid receiver, connecting piping, or evaporator.

Machinery room: A room in which a refrigerating system is permanently installed and operated, but not including evaporators located in a cold storage room, refrigerator box, air cooled space or other enclosed space. Closets solely contained within, and opening only into, a room shall not be considered machinery rooms but shall be considered a part of the machinery room in which they are contained or open into. It is not the intent of this definition to cause the space in which a self-contained system is located to be classified as a machinery room.

Machinery room, Class T: A machinery room with specific restrictions and requirements (See Section M-810.12.5).

Nonpositive displacement compressor: A compressor in which increase in pressure is attained without changing the internal volume of the compression chamber.

Piping: The pipe or tube mains for inter-connecting the various parts of a refrigerating system. Piping includes pipe; flanges; bolting; gaskets; valves; fittings; the pressure-containing parts of other components such as expansion joints and strainers; devices which serve such purposes as mixing, separating, snubbing, distributing, metering or controlling flow; pipe supporting fixtures and structural attachments.

Positive displacement compressor: A compressor in which increase in pressure is attained by changing the internal volume of the compression chamber.

Pressure-imposing element: Any device or portion of the equipment used for the purpose of increasing the refrigerant pressure.

Pressure-limiting device: A pressure-responsive mechanism designed to automatically stop the operation of the pressure-imposing element at a predetermined pressure.

Pressure vessel: Any refrigerant-containing receptacle of a refrigerating system, other than evaporators [each separate section of which does not exceed one-half (½) cubic foot of refrigerant-containing volume], evaporator coils, compressors, condenser coils, controls, headers and piping.

Refrigerant: A substance used to produce refrigeration by its expansion or vaporization.

Refrigerating system: A combination of interconnected refrigerant-containing parts constituting one (1) closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting heat (see Section M-803.0 for classification of refrigerating systems by type).

Saturation pressure of a refrigerant: The pressure at which there is stable coexistence of the vapor and liquid or the vapor and solid phase.

Sealed absorption system: A unit system for Group 2 refrigerants only in which all refrigerant-containing parts are made permanently tight by welding or brazing against refrigerant loss (see Sections M-805.1.2 and M-805.3.1 for restrictions).

Self-contained system: A complete factory-made and factory-tested system in a suitable frame or enclosure which is fabricated and shipped in one (1) or more sections and in which refrigerant-containing parts are not connected in the field other than by companion or block valves.

SECTION M-802.0 OCCUPANCY CLASSIFICATIONS

M-802.1 General: Locations governed by this article in which refrigerating systems may be placed are grouped by occupancy as follows.

M-802.2 Institutional occupancy: Institutional occupancy shall apply to that portion of the premises in which persons are confined to receive medical, charitable, educational or other care or treatment, or in which persons are held or detained by reason of public or civic duty, including among others, hospitals, asylums, sanitariums, police stations, jails, court houses with cells and similar occupancies.

M-802.3 Public assembly: Public assembly occupancy shall apply to that portion of the premises in which persons congregate for civic, political, educational, religious, social, or recreational purposes including among others, armories, assembly rooms, auditoriums, ballrooms, bath houses, bus terminals, broadcasting studios, churches, colleges, court houses without cells, dance halls, department stores, exhibition halls, fraternity halls, libraries, lodge rooms, mortuary chapels, museums, passenger depots, schools, skating rinks, subway stations, theaters and similar occupancies.

M-802.4 Residential occupancy: Residential occupancy shall apply to that portion of the premises in which sleeping accommodations are provided, including among others, club houses, convents, dormitories, hotels, lodging houses, multiple story apartments, residences, studios, tenements and similar occupancies.

M-802.5 Commercial occupancy: Commercial occupancy shall apply to that portion of the premises used for the transaction of business; for the rendering of professional services; for the supplying of food, drink, or other bodily needs and comforts; for manufacturing purposes or for the performance of work or labor (except as included under Section M-802.6) including among others, bake shops, fur storage, laboratories, loft buildings, markets, office buildings, professional buildings, restaurants, stores other than department stores and similar occupancies.

M-802.6 Industrial occupancy: Industrial occupancy shall apply to an entire building or premises or to that portion of a building used for manufacturing, processing, or storage of materials or products, including among others, chemical, food, candy and ice cream factories, ice making plants, meat packing plants, refineries, perishable food warehouses and similar occupancies, provided the entire building is occupied by a single tenant. In an "industrial occupancy", when the number of persons in a refrigerated space, served by a direct system, on any floor above the first floor (ground level or deck level) exceeds one (1) person per one hundred (100) square feet of floor area, the requirements of "commercial occupancy" shall apply unless that refrigerated space containing more than one (1) person per one hundred (100) square feet of floor area above the first floor is provided with the required number of doors opening directly into approved building exitways. Such refrigerated space shall be cut off from the rest of the building by tight construction with tight-fitting doors.

> **Note:** The above does not prohibit openings for the passage of products from one refrigerated space to another refrigerated space.

M-802.7 Mixed occupancy: Mixed occupancy shall apply to a building occupied or used for different purposes in different parts. When the occupancies are cut off from the rest of the building by tight partitions, floors, and ceilings and protected by self-closing doors, the requirements for each type of occupancy shall apply for its portion of the building or premises. For example, the cold storage spaces in retail frozen food lockers, hotels, and department stores in buildings occupied by a single tenant might be classified under "industrial occupancy", whereas other portions of the building would be classified under other occupancies. When the occupancies are not so separated, the occupancy carrying the more stringent requirements shall govern.

M-802.8 Adjacent locations: Equipment installed in locations adjacent to areas outlined in Section M-802.2 through Section M-802.7, including outdoor installations, shall be governed by the applicable requirements of this code.

SECTION M-803.0 REFRIGERATING SYSTEMS CLASSIFICATION BY TYPE

M-803.1 General: Refrigerating systems are classified by the method employed for extracting heat as described in the following Sections M-803.2 through M-803.4.

M-803.2 Direct system: Direct system is one in which the evaporator is in direct contact with the material or space refrigerated, or is located in air-circulating passages communicating with such spaces.

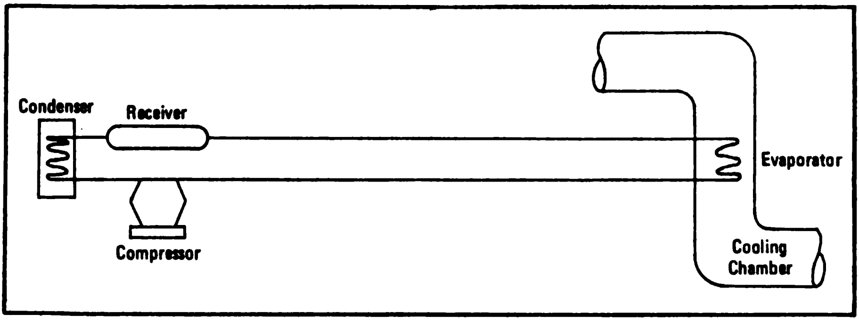


Fig. M-803.2
DIRECT SYSTEM

M-803.3 Double direct system: Double direct system is one in which an evaporate refrigerant is used in a secondary circuit to condense or cool a refrigerant in a primary circuit. For the purpose of this code, each system enclosing a separate body of an evaporate refrigerant shall be considered as a separate direct system.

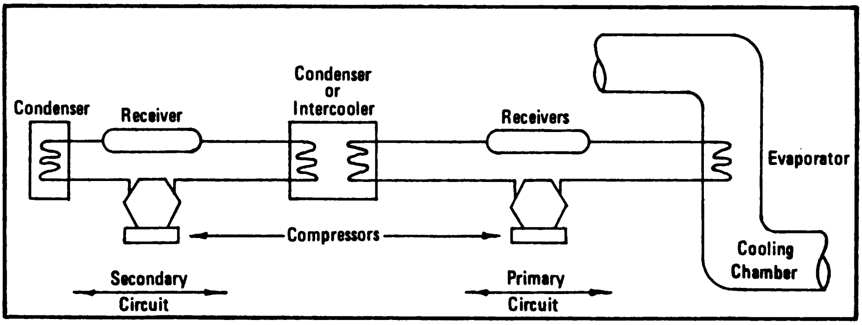


Fig. M-803.3
DOUBLE DIRECT SYSTEM

M-803.4 Indirect system: Indirect system is one in which a brine cooled by the refrigerant is circulated to the material or space refrigerated or is used to cool air so circulated. Indirect systems which are distinguished by the type or method of application are as given in the following Sections M-803.4.1 through M-803.4.4.

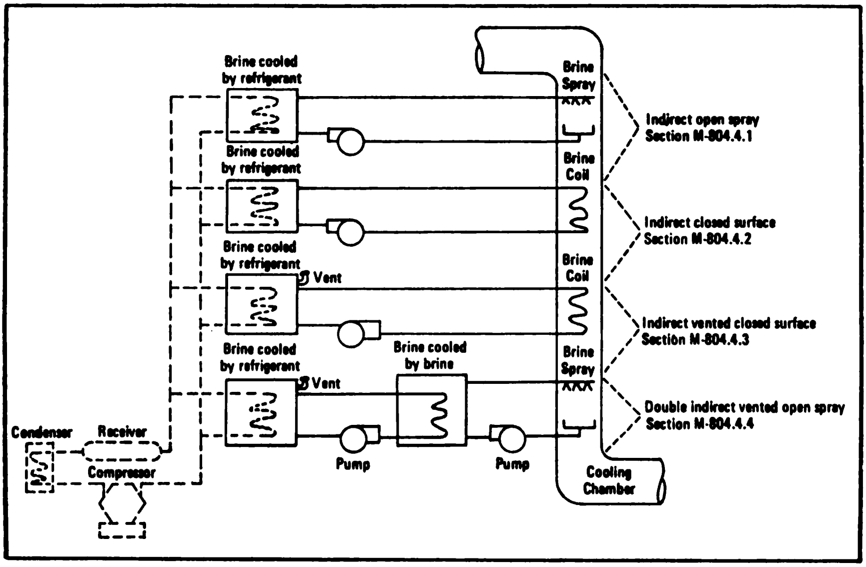

Brine cooled by refrigerant
Brine Spray
Indirect open spray Section M-804.4.1
Brine cooled by refrigerant
Brine Coil
Indirect closed surface Section M-804.4.2
Brine cooled by refrigerant
Vent
Brine Coil
Indirect vented closed surface Section M-804.4.3
Brine cooled by refrigerant
Brine cooled by brine
Brine Spray
Vent
Double indirect vented open spray Section M-804.4.4
Condenser
Receiver
Compressor
Pump
Pump
Cooling Chamber

Fig. M-803.4
INDIRECT SYSTEMS

M-803.4.1 Indirect open-spray system is one in which a brine cooled by an evaporator located in an enclosure external to a cooling chamber is circulated to such cooling chamber and is sprayed therein.

M-803.4.2 Indirect closed-surface system is one in which a brine, cooled by an evaporator located in an enclosure external to a cooling chamber, is circulated to and through such a cooling chamber in pipes or other closed circuits.

M-803.4.3 Indirect vented closed-surface system is one in which a brine, cooled by an evaporator located in a vented enclosure external to a cooling chamber, is circulated to and through such cooling chamber in pipes or other closed circuits.

M-803.4.4 Double indirect vented open-spray system is one in which a brine, cooled by an evaporator located in a vented enclosure, is circulated through a closed circuit to a second enclosure where it cools another supply of a brine, and this liquid in turn is circulated to a cooling chamber and is sprayed therein.

SECTION M-804.0 REFRIGERANT CLASSIFICATION

M-804.1 **General:** Refrigerants shall be classified by their toxicity or flammability and accordingly are divided into groups as described in Sections M-804.2 through M-804.4.

M-804.2 Group 1: Group 1 refrigerants shall include the following.

Refrigerant*	Name	Chemical formula
R-11	Trichlorofluoromethane	CCl_3F
R-12	Dichlorodifluoromethane	CCl_2F_2
R-13	Chlorotrifluoromethane	$CClF_3$
R-13B1	Bromotrifluoromethane	$CBrF_3$
R-14	Tetrafluoromethane	CF_4
R-21	Dichlorofluoromethane	$CHCl_2F$
R-22	Chlorodifluoromethane	$CHClF_2$
R-30	Dichloromethane (Methylene chloride)	CH_2Cl_2
R-113	Trichlorotrifluoroethane	CCl_2FCClF_2
R-114	Dichlorotetrafluoroethane	$CClF_2CClF_2$
R-115	Chloropentafluoroethane	$CClF_2CF_3$
R-C318	Octafluorocyclobutane	C_4F_8
R-500	Dichlorodifluoromethane, 73.8% and Ethylidene Fluoride, 26.2%	CCl_2F_2/CH_3CHF_2
R-502	Chlorodifluoromethane, 48.8% and Chloropentafluoroethane, 51.2%	$CHClF_2/CClF_2CF_3$
R-744	Carbon dioxide	CO_2

M-804.3 Group 2: Group 2 refrigerants shall include the following.

Refrigerant*	Name	Chemical formula
R-40	Methyl chloride	CH_3Cl
R-611	Methyl formate	$HCOOCH_3$
R-717	Ammonia	NH_3
R-764	Sulphur dioxide	SO_2

M-804.4 Group 3: Group 3 refrigerants shall include the following.

Refrigerant*	Name	Chemical formula
R-170	Ethane	C_2H_6
R-290	Propane	C_3H_8
R-600	Butane	C_4H_{10}
R-601	Isobutane	$CH(CH_3)_3$
R-1150	Ethylene	C_2H_4

*Numerical refrigerant designation, see American National Standard B79.1 as listed in Appendix B.

SECTION M-805.0 REQUIREMENTS FOR INSTITUTIONAL, PUBLIC ASSEMBLY, RESIDENTIAL AND COMMERCIAL OCCUPANCIES

M-805.1 General

M-805.1.1 Public stairway, stair landing, entrance or exit: A refrigerating system shall not be installed in or on a public stairway, stair landing, entrance or exit.

M-805.1.2 Public hallway or lobby: A refrigerating system shall not interfere with free passage. A Group 2 refrigerant shall not be permitted in public hallways or lobbies of institutional or public assembly occupancies. Refrigerating systems installed in a public hallway or lobby shall be limited to:

1. unit systems containing not more than the quantities of a Group 1 refrigerant specified in Table M-805.2; or
2. sealed absorption systems containing not more than three (3) pounds of Group 2 refrigerant when in residential and commercial occupancies.

M-805.1.3 When the refrigerant-containing parts of a system are located in one (1) or more enclosed spaces, the cubical content of the smallest enclosed humanly occupied space, other than the machinery room, shall be used to determine the permissible quantity of refrigerant in the system. Where a refrigerating system has evaporator coils serving individual stories of a building, the story having the smallest volume shall be used to determine the maximum quantity of refrigerant in the entire system.

M-805.1.4 When the evaporator is located in an air duct system, cubical content of the smallest humanly occupied enclosed space served by the air duct system shall be used to determine the permissible quantity of refrigerant in the system; however, if the air flow to any enclosed space served by the air duct system cannot be shut off or reduced below one-quarter (¼) of its maximum, the cubical contents of the entire space served by the air duct system may be used to determine the permissible quantity of refrigerant in the system.

M-805.1.5 In institutional and public assembly occupancies, direct expansion coils or evaporators used for air conditioning and located downstream from, and in proximity to, a heating coil or located upstream within eighteen (18) inches of a heating coil shall be fitted with a pressure relief device discharging to the outside of the building in an approved manner; except that such a relief device shall not be required on unit or self-contained systems if the internal volume of the low side of the system which may be shut off by valves, divided by the total weight of refrigerant in the system less the weight of refrigerant vapor contained in the other parts of the system at one hundred ten (110) degrees F., exceeds the specific volume of the refrigerant at critical conditions of temperature and pressure.

Note: The above exemption is also stated in formula form below.

$$\frac{V_1}{W_1 - W_2} \text{ shall be more than } V_{sp}$$

Where V_1 = low side volume, cu. ft.
V_{sp} = specific volume at critical conditions of temperature and pressure, cu. ft. per lb.
W_1 = total weight of refrigerant in system, lb.
W_2 = weight of refrigerant vapor (lb.) at 110 F in V_2,

$$= \frac{V_2}{\text{specific volume of refrigerant, in cu. ft. per lb., at 110 F}}$$

where V_2 = total volume of system less V_1 cu. ft.

M-805.2 Group 1 refrigerants

M-805.2.1 Direct systems: The maximum permissible quantity of a Group 1 refrigerant in a direct system shall be as specified in Table M-805.2 except for additional limitations specified in Section M-805.2.1.1.

Table M-805.2

MAXIMUM PERMISSIBLE QUANTITIES OF GROUP 1 REFRIGERANTS FOR DIRECT SYSTEMS

Refrigerant	Name	Maximum quantity in lb. per 1000 cu. ft. of humanly occupied space*
R-11	Trichlorofluoromethane	35
R-12	Dichlorodifluoromethane	31
R-13	Chlorotrifluoromethane	27
R-13B1	Bromotrifluoromethane	38
R-14	Tetrafluoromethane	23
R-21	Dichlorofluoromethane	13
R-22	Chlorodifluoromethane	22
R-30	Dichloromethane (Methylene chloride)	6
R-113	Trichlorotrifluoroethane	24
R-114	Dichlorotetrafluoroethane	44
R-115	Chloropentafluoroethane	40
R-C318	Octafluorocyclobutane	50
R-500	Dichlorodifluoromethane, 73.8% and Ethylidene Fluoride, 26.2%	26
R-502	Chlorodifluoromethane, 48.8% and Chloropentafluoroethane, 51.2%	30
R-744	Carbon dioxide	11

*Volatile charge in a control shall not be considered as refrigerant.

M-805.2.1.1 Direct systems in institutional occupancies shall be limited to systems each containing not more than fifty (50) per cent of the permissible quantities of Group 1 refrigerants specified in Table M-805.2 except in kitchens, laboratories and mortuaries.

M-805.2.2 Indirect systems: A system containing more than the quantity of a Group 1 refrigerant allowed in Table M-805.2 shall be of the indirect type with all refrigerant-containing parts (except parts mounted outside the building and piping installed in accordance with Section M-810.11.3), installed in a machinery room not used for any other purpose than for mechanical equipment.

M-805.2.3 Open flames in machinery rooms: An open flame or apparatus to produce an open flame shall not be installed in a machinery room where any refrigerant other than carbon dioxide is used, unless the flame is enclosed and vented to the open air. The use of matches, cigarette lighters, halide leak detectors and similar devices shall not be considered a violation of this section or of Section M-805.2.4.

M-805.2.4 Open flames in institutional occupancies: In institutional occupancies where more than one (1) pound of a Group 1 refrigerant, other than carbon dioxide, is used in a system, any portion of which is in a room where there is an apparatus for producing an open flame, then such refrigerant shall be classed in Group 2, unless the flame-producing apparatus is provided with a hood and flue capable of removing the products of combustion to the open air.

M-805.3 Group 2 refrigerants

M-805.3.1 Direct systems: Direct systems containing Group 2 refrigerants shall not be used for air conditioning for human comfort. For other applications, the maximum permissible quantity of Group 2 refrigerants in a direct system shall be as specified in Table M-805.3.1.

Table M-805.3.1

MAXIMUM PERMISSIBLE QUANTITIES OF GROUP 2 REFRIGERANTS FOR DIRECT SYSTEMS

Type of refrigerating system	Maximum pounds for various occupancies			
	Institutional	Public assembly	Residential	Commercial
Sealed absorption systems:				
a) In public hallways or lobbies	0	0	3	3
b) In other than public hallways or lobbies	0*	6	6	20
Self-contained or unit systems:				
a) In public hallways or lobbies	0	0	0	0
b) In other than public hallways or lobbies	0	0*	6	20

*Six pounds allowed when installed in kitchens, laboratories and mortuaries.

M-805.3.2 Indirect systems: The maximum permissible quantity of Group 2 refrigerant in any indirect system shall be as specified in Table M-805.3.2. Such systems shall be of the following types.

1. Institutional and public assembly occupancies; indirect vented closed-surface or double indirect vented open spray.
2. Residential and commercial occupancies; indirect closed-surface, indirect vented closed-surface, or double indirect vented open-spray or secondary circuit or double direct type.

Table M-805.3.2

MAXIMUM PERMISSIBLE QUANTITIES OF GROUP 2 REFRIGERANTS FOR INDIRECT SYSTEMS

Occupancy	Column 1 machinery rooms max. lb.	Column 2 Class T machinery rooms max. lb.
Institutional	0	500
Public assembly	0	1000
Residential	300	No limit
Commercial	600	No limit

M-805.3.2.1 Indirect systems using Group 2 refrigerants not in excess of the quantities shown in Column 1 of Table M-805.3.2 shall have all refrigerant-containing parts, except parts mounted outside the building and piping installed in accordance with Section M-810.11.3, installed in a machinery room not used for any other purpose than for mechanical equipment.

M-805.3.2.2 Indirect systems using Group 2 refrigerants not in excess of the quantities shown in Column 2 of Table M-805.3.2 shall have all refrigerant-containing parts, except parts mounted outside the building and piping installed in accordance with Section M-810.11.3, installed in a Class T machinery room.

M-805.3.2.3 Flame-producing devices, hot surfaces, and electrical equipment in machinery rooms: Where a machinery room is required by this code to house a refrigerating system containing any Group 2 refrigerant other than sulphur dioxide, a flame-producing device or hot surface above eight hundred (800) degrees F shall not be permitted in such room, and all electrical equipment in the room shall conform to the requirements of Hazardous Locations Class I, Division 2, of the National Electrical Code listed in Appendix B. The use of matches, cigarette lighters, halide leak detectors, combustion engines, gas turbines and similar devices shall not be considered a violation of this section, provided the quantities of Group 2 refrigerants in Table M-806.2 are not exceeded.

M-805.3.2.4 Group 2 refrigerants listed in Table M-806.2 shall not be used in a refrigerating system in excess of one thousand (1,000) pounds unless approved by the authority having jurisdiction.

M-805.4 Group 3 refrigerants

M-805.4.1 Group 3 refrigerants shall not be used in institutional, public assembly, residential or commercial occupancies except in laboratories for commercial occupancies. In such laboratory installations, only unit systems containing not more than six (6) pounds shall be used unless the number of persons does not exceed one (1) person per one hundred (100) square feet of laboratory floor area, in which case the requirements of Section M-806.0 shall apply.

SECTION M-806.0 REQUIREMENTS FOR INDUSTRIAL OCCUPANCIES

M-806.1 **General:** There shall not be restrictions on the quantity or kind of refrigerant used in an industrial occupancy, except as specified in Sections M-806.2 and M-806.3.

M-806.2 **Open flames:** When the quantity of flammable refrigerant in any one (1) refrigerating system exceeds the amount given in Table M-806.2 for each one thousand (1,000) cubic feet of room volume in which the system or any part thereof is installed, then a flame-producing device or hot surface above eight hundred (800) degrees F. shall not be permitted in such room, and all electrical equipment in the room shall conform to the requirements of Hazardous Locations Class 1, Division 2, of the National Electrical Code listed in Appendix B.

Table M-806.2

MAXIMUM PERMISSIBLE QUANTITIES OF FLAMMABLE REFRIGERANTS

Refrigerant	Group	Name	Maximum Quantity in lb. per 1000 cu. ft. of room volume
R-40	2	Methyl chloride	10
R-611	2	Methyl formate	7
R-170	3	Ethane	2½
R-290	3	Propane	2½
R-600	3	Butane	2½
R-601	3	Isobutane	2½
R-1150	3	Ethylene	2

M-806.3 **Flammable refrigerants:** Flammable refrigerants as listed in Table M-806.2 shall not be used in a refrigerating system in excess of one thousand (1,000) pounds unless approved by the authority having jurisdiction.

SECTION M-807.0 DESIGN AND CONSTRUCTION OF EQUIPMENT

M-807.1 Materials

M-807.1.1 All materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Some refrigerants are corrosive to the usual materials when moisture or air, or both, are present. Material shall not be used that will deteriorate because of the refrigerant, or the oil, or a combination of both.

M-807.1.2 Aluminum, zinc, or magnesium shall not be used in contact with methyl chloride in a refrigerating system. Magnesium alloys shall not be used in contact with any halogenated refrigerant.

M-807.2 Design pressure

M-807.2.1 Design pressures shall be selected high enough for all operating and standby conditions. When selecting the design pressure, consideration shall be given to allowances for setting pressure-limiting devices and pressure-relief devices sufficiently above operating conditions for shipping conditions and to avoid nuisance shutdowns. Minimum design pressure shall not be less than fifteen (15) psig, and, except as noted in Sections M-807.2.2, M-807.2.3 and M-807.2.4, shall not be less than the saturation pressure of the refrigerant at the following temperatures:

1. low sides of all systems, +80° F.;
2. high sides of water or evaporatively cooled systems, +105° F.; and
3. high sides of air cooled systems, +125° F.

Corresponding pressures are given in Table M-807.2 for the refrigerants in common use.

M-807.2.2 The design pressure for either the high or low side need not exceed the critical pressure of the refrigerant, unless the system is intended to operate at these conditions.

M-807.2.3 When a part of a limited charged system is protected by a pressure-relief device, the design pressure of that part need not exceed the setting of the pressure-relief device.

M-807.2.4 When a compressor is used as a booster to obtain a low pressure and discharges into the suction side of another system, the booster compressor is considered a part of the low side, provided that a low pressure stage compressor of the positive displacement type is protected by a pressure-relief device.

M-807.2.5 Any components connected to pressure vessels shall have a design pressure equal to or greater than the pressure vessels.

M-807.3 Refrigerant-containing pressure vessels

M-807.3.1 Pressure vessels exceeding six (6) inches inside diameter, except those having a maximum internal or external design pressure fifteen (15) psig or less, shall comply with the rules of Section VIII of the ASME Boiler and Pressure Vessel Code listed in Appendix B covering the requirements for the design, fabrication, inspection and testing during construction of unfired pressure vessels.

Table M-807.2

MINIMUM* DESIGN PRESSURES

		Minimum design pressures, psig**		
			High side	
Refrigerant	Name	Low side	Water or evap. cooled	Air cooled
R-11	Trichlorofluoromethane	15	15	21
R-12	Dichlorodifluoromethane	85	127	169
R-13	Chlorotrifluoromethane	521	547	547
R-13B1	Bromotrifluoromethane	230	321	410
R-14	Tetrafluoromethane	544	544	544
R-21	Dichlorofluoromethane	15	29	46
R-22	Chlorodifluoromethane	144	211	278
R-30	Methylene Chloride	15	15	15
R-40	Methyl Chloride	72	112	151
R-113	Trichlorotrifluoroethane	15	15	15
R-114	Dichlorotetrafluoroethane	18	35	53
R-115	Chloropentafluoroethane	152	194	252
R-170	Ethane	616	709	709
R-290	Propane	129	188	244
R-C318	Octafluorocyclobutane	34	59	85
R-500	Dichlorodifluoromethane, 73.8% and Ethylidene Fluoride, 26.2%	102	153	203
R-502	Chlorodifluoromethane, 48.8% and Chloropentafluoroethane, 51.2%	162	232	302
R-600	N-Butane	23	42	61
R-601	Isobutane	39	63	88
R-611	Methyl Formate	15	15	15
R-717	Ammonia	139	215	293
R-744	Carbon Dioxide	955	1058	1058
R-764	Sulfur Dioxide	45	78	115
R-1150	Ethylene	732	732	732

*Selection of higher design pressures may be required to satisfy actual shipping, operating or standby conditions.

**Corresponding to specified saturation pressure at 14.7 psia atmospheric pressure.

M-807.3.2 Pressure vessels not exceeding six (6) inches inside diameter, except those having a maximum internal or external design pressure of fifteen (15) psig or less, shall be listed either individually, or as part of refrigeration equipment, by a nationally recognized testing or inspection agency, or shall be constructed according to Section M-807.3.1.

M-807.3.3 Pressure vessels having a maximum internal or external design pressure of fifteen (15) psig or less, except as noted in Sections M-807.3.4 and M-807.3.5, shall have an ultimate strength to withstand at least three (3) times the design pressure and shall be tested to at least one and one-third (1⅓) times the design pressure for which they are rated.

M-807.3.4 If a pressure-relief device is used to protect a pressure vessel not exceeding six (6) inches inside diameter, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand at least two and one-half (2½) times the pressure setting of the pressure-relief device.

M-807.3.5 If a fusible plug is used to protect a pressure vessel not exceeding six (6) inches inside diameter, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand at least two and one-half (2½) times the refrigerant saturation pressure corresponding to the stamped temperature on the fusible plug, or at least two and one-half (2½) times the critical pressure of the refrigerant used, whichever is smaller.

M-807.4 Refrigerant piping, valves, fittings and related parts

M-807.4.1 General: Refrigerating piping, valves, fittings and related parts, except those having a maximum internal or external design pressure fifteen (15) psig or less, shall be listed either individually or as part of refrigeration equipment by a nationally recognized testing or inspection agency, or shall comply with the rules of Section 5 of the ANSI Code for Pressure Piping, listed in Appendix B, where applicable, and to the following requirements.

M-807.4.2 Specific minimum requirements for unprotected refrigerant pipe and tubing

M-807.4.2.1 Unprotected watertube size hard copper tubing used for refrigerant piping erected on the premises shall conform to ASTM Specifications B88, listed in Appendix C, Types K or L for dimensions and specifications. Copper tubing with an outside diameter of one-fourth (¼) inch shall have a minimum nominal wall thickness of not less than thirty one-thousandths (0.030) inch.

M-807.4.2.2 Unprotected soft annealed copper tubing used for refrigerant piping erected on the premises shall not be used in sizes larger than one and three-eighths (1⅜) inch outside diameter. It shall conform to ASTM Specifications B280 listed in Appendix C. Minimum nominal wall thickness of soft unprotected annealed copper tubing shall be as shown in the following Table M-807.4.

M-807.4.3 Metal enclosures or pipe ducts for soft copper tubing: Rigid or flexible metal enclosures shall be provided for soft annealed copper tubing used for refrigerant piping erected on the premises and containing Group 2 or 3 refrigerants, except that enclosures shall not be required for connections between condensing unit and the nearest riser box, provided such connections do not exceed six (6) feet in length.

M-807.4.4 Joints on copper tubing used in refrigerating systems containing Group 2 or Group 3 refrigerants shall be brazed joints. Soldered joints shall not be used in such refrigerating systems.

Table M-807.4

WALL THICKNESS OF SOFT, UNPROTECTED ANNEALED COPPER TUBING

Standard size in.	Outside diameter in.	Wall thickness in.
¼	0.250	0.030
⅜	0.375	0.030
½	0.500	0.032
⅝	0.625	0.035
¾	0.750	0.042
⅞	0.875	0.045
1	1.000*	0.050
1⅛	1.125	0.050
1¼	1.250*	0.055
1⅜	1.375	0.055

*Not included as standard size in ASTM B280

M-807.5 Components other than pressure vessels and piping

M-807.5.1 Every pressure-containing component of a refrigerating system, other than pressure vessels, piping, pressure gauges and control mechanisms, shall be listed either individually, or as part of refrigeration equipment, by a nationally recognized testing or inspection agency or shall be designed, constructed and assembled to have an ultimate strength sufficient to withstand at least three (3) times the design pressure for which it is rated.

M-807.5.2 Liquid level gauge glasses, except those of the bull's-eye or reflex type, shall have automatic closing shut-off valves, and such glasses shall be adequately protected against injury.

M-807.5.3 Dial of a pressure gauge, when the gauge is permanently installed on the high side of a refrigerating system, shall be graduated to at least one and two-tenths (1.2) times the design pressure.

M-807.5.4 Liquid receivers or parts of a system designed to receive the refrigerant charge during pumpdown shall have sufficient capacity to receive the charge without the liquid occupying more than ninety (90) per cent of the volume when the temperature of the refrigerant is ninety (90) degrees F.

M-807.5.5 Butt welded steel, other than open hearth type which is not rephosphorized, or wrought iron pipe shall not be used for evaporator or condenser coils.

M-807.6 Service provisions

M-807.6.1 General: All systems shall have provisions to handle safely the refrigerant charge for service purposes. Properly located stop valves, separate storage tanks or adequate venting for safe disposal are satisfactory for this purpose.

M-807.6.2 Systems containing more than six (6) pounds of a Group 2 or 3 refrigerant, other than systems utilizing nonpositive displacement compressors, shall have stop valves installed as follows:

1. each inlet of each compressor, compressor unit, or condensing unit; and
2. each discharge outlet of each compressor, compressor unit, or condensing unit and of each liquid receiver.

M-807.6.3 Systems containing 100 pounds or more of refrigerant: All systems containing one hundred (100) pounds or more of a refrigerant, other than systems utilizing non-positive displacement compressors, shall have stop valves, in addition to those in Section M-807.6.2, on each inlet of each liquid receiver except on the inlet of a receiver in a condensing unit or on the inlet of a receiver which is an integral part of a condenser.

M-807.6.4 Stop valves used for soft annealed copper tubing or hard drawn copper tubing seven-eighths (⅞) inch outside diameter or smaller shall be securely mounted independent of tubing, fastenings or supports.

M-807.6.5 Stop valves shall be suitably labeled if it is not obvious what they control. Numbers may be used to label the valves provided a key to the numbers is located near the valves.

M-807.7 Factory tests

M-807.7.1 Every refrigerant-containing part of every system shall be tested and proved tight by the manufacturer at not less than the design pressure for which it is rated, except as noted in Sections M-807.7.2, M-807.7.3 and M-807.7.3.1.

M-807.7.2 Pressure vessels shall be tested in accordance with Section M-807.3.

M-807.7.3 The test pressure applied to the high side of each factory-assembled refrigerating system shall be at least equal to the design pressure of the component in the high side which has the lowest rated design pressure. The test pressure applied to the low side of each factory-assembled refrigerating system shall be at least equal to the design pressure of the component in the low side which has the lowest rated design pressure.

M-807.7.3.1 In testing systems using nonpositive displacement compressors, the entire system shall be considered for test purposes at the low side pressure.

M-807.8 Nameplate: Each unit system and each separate condensing unit, compressor or compressor unit sold for field assembly in a refrigerating system shall carry a nameplate marked with the manufacturer's name, nationally registered trademark or trade name, identification number, the design pressures and the refrigerant for which it is designed. The refrigerant shall be designated according to ANSI B79, Number Designation of Refrigerant, listed in Appendix B.

SECTION M-808.0 PRESSURE-LIMITING DEVICES

M-808.1 General: Pressure-limiting devices shall be provided on all systems containing more than twenty (20) pounds of refrigerant and operating above atmospheric pressure, and on all water-cooled systems so constructed that the compressor or generator is capable of producing a pressure in excess of the high side design pressure, except water-cooled unit systems containing not more than three (3) pounds of a Group 1 refrigerant, providing the operating pressure developed in the system with the water supply shut off does not exceed one-fifth (⅕) the ultimate strength of the system, or providing an overload device will stop the action of the compressor before the pressure exceeds one-fifth (⅕) the ultimate strength of the system.

M-808.1.1 Lubricating oil protection control: Pressure lubricated positive displacement compressors having a displacement exceeding fifty (50) cubic feet per minute (cfm) shall be equipped with an approved control device, requiring manual resetting, which will stop the action of the compressor in the event of loss of adequate lubricating oil pressure.

M-808.2 Maximum setting: When required by Section M-808.1, the maximum setting to which a pressure-limiting device may readily be set by use of the adjusting means provided shall not exceed the design pressure of the high side of a system which is not protected by a pressure-relief device or ninety (90) per cent of the setting of the pressure-relief device installed on the high side of a system, except as provided in Section M-808.2.1. The pressure-limiting device shall stop the action of the pressure-imposing element at a pressure not higher than this maximum setting.

M-808.2.1 On systems using nonpositive displacement compressors, the pressure-limiting device may be set at the design pressure of the high side of the system, provided the pressure-relief device is subject to low side pressure, and stop valves are not on the system.

M-808.3 Pressure-limiting devices: Pressure-limiting devices, when required by Section M-808.1, shall be connected between the pressure-imposing element and any stop valve on the discharge side without intervening stop valves in the line leading to the pressure-limiting device.

SECTION M-809.0 PRESSURE-RELIEF PROTECTION

M-809.1 General: Every refrigerating system shall be protected by a pressure-relief device, or some other means designed to safely relieve pressure due to fire or other abnormal conditions.

M-809.1.1 In addition, all pressure vessels shall be protected in accordance with the requirements of Section M-809.4.

M-809.1.2 All pressure-relief devices (not fusible plugs) shall be directly pressure-actuated. Each part of a refrigerating system which can be valved off and which contains one (1) or more pressure vessels having internal diameters greater than six (6) inches and containing liquid refrigerant shall be protected by a pressure-relief device.

M-809.1.3 Stop valves shall not be located between the means of pressure relief and the part or parts of the system protected thereby, except when the parallel relief devices mentioned in Section M-809.4.2.2 are so arranged that only one (1) can be rendered inoperative at a time for testing or repair purposes.

M-809.1.4 All pressure-relief devices shall be connected as nearly as practicable directly to the pressure vessel or other parts of the system protected thereby, above the liquid refrigerant level, and installed so that they are readily accessible for inspection and repair, and so that they cannot be readily rendered inoperative. Fusible plugs may be located above or below the liquid refrigerant level except on the low side.

M-809.1.5 The seats and discs of pressure-relief devices shall be constructed of suitable material to resist refrigerant corrosion or other chemical action caused by the refrigerant. Seats or discs of cast iron shall not be used.

M-809.2 Setting of pressure-relief devices

M-809.2.1 **Pressure-relief valve setting:** All pressure-relief valves shall be set to start to function at a pressure not to exceed the design pressure of the parts of the system protected.

M-809.2.2 **Rupture member setting:** All rupture members used in lieu of, or in series with, a relief valve shall have a nominal rated rupture pressure not to exceed the design pressure of the parts of the system protected. The conditions of application shall conform to the requirements of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code listed in Appendix B. Rupture members installed ahead of relief valves need not be larger, but shall not be smaller, than the relief valve inlet.

M-809.3 Marking of relief devices and fusible plugs

M-809.3.1 All pressure-relief valves for refrigerant-containing components shall be set and sealed by the manufacturer. Each pressure-relief valve shall be marked by the manufacturer with the data required in Paragraph UG-129 (a) of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code, listed in Appendix B, except relief valves for systems with design pressures of fifteen (15) psig or less may be marked by the manufacturer with the pressure setting and capacity.

M-809.3.2 Each rupture member for refrigerant-containing pressure vessels shall be marked with the data required in Paragraph UG-129 (d) of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code listed in Appendix B.

M-809.3.3 Fusible plugs shall be marked with the melting temperature in degrees F.

M-809.4 Pressure vessel protection

M-809.4.1 General: Pressure vessels shall be provided with pressure relief protection in accordance with rules given in Paragraphs UG-125 to UG-134, inclusive, of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code, listed in Appendix B, with such additional modifications as are necessary for control of refrigerants.

M-809.4.2 Pressure vessels over three cubic feet: Each pressure vessel containing liquid refrigerant with internal gross volume exceeding three (3) cubic feet, except as specified in Section M-809.4.4, and which may be shut off by valves from all other parts of a refrigerating system, shall be protected by a pressure-relief device having sufficient capacity to prevent the pressure in the pressure vessel from rising more than ten (10) per cent above the setting of the pressure-relief device.

M-809.4.2.1 Pressure vessels over three cubic feet, but less than ten cubic feet: Under conditions specified in Section 809.4.2, a single pressure-relief device may be used on pressure vessels having less than ten (10) cubic feet internal gross volume.

M-809.4.2.2 Pressure vessels of ten cubic feet internal gross volume or over: Under conditions specified in Section M-809.4.2, if a pressure-relief valve is used, a relief device system consisting of pressure-relief valve in parallel with a second pressure-relief valve, as described in Section M-809.1.3, shall be provided on pressure vessels having internal gross volume of ten (10) cubic feet or over. Each pressure-relief valve shall have sufficient capacity to prevent the pressure in the pressure vessel from rising more than ten (10) per cent above the setting of the pressure-relief valve.

M-809.4.2.2.1 Pressure-relief valves discharging into low side of the system: Under conditions permitted in Section M-809.4.8.1, a single relief valve (not rupture member) of the required relieving capacity may be used on vessels of ten (10) cubic feet or over.

M-809.4.2.3 Pressure-relief devices in parallel on large vessels: In cases where large pressure vessels containing liquid refrigerant, except as specified in Section M-809.4.4, require the use of two (2) or more pressure-relief devices in parallel to obtain the capacity required, the battery of pressure-relief devices shall be considered as a unit, and therefore as one (1) pressure-relief device.

M-809.4.3 Pressure vessels with internal gross volume of three cubic feet or less: Each pressure vessel having an internal gross volume of three (3) cubic feet or less containing liquid refrgierant, execpt as specified in Section M-809.4.4, and which may be shut off by valves from all other parts of a refrigerating system shall be protected by a pressure-relief device or fusible plug. Pressure vessels of less than three (3) inch inside diameter are exempt from these requirements.

M-809.4.4 Pressure-relief device for pressure vessels used as, or as part of, evaporator: Pressure vessels having internal diameters greater than six (6) inches used as, or as part of, evaporators insulated or installed in insulated space and which may be shut off by valves from all other parts of a refrigerating system shall be protected by a pressure-relief device in accordance with the provisions of Sections M-809.4.2, and M-809.4.3, except that the provisions of Section M-809.4.2.2, requiring a second parallel pressure-relief valve, shall not apply. Pressure vessels used as evaporators, having internal diameters of six (6) inches or less, are exempt from pressure-relief device requirements.

M-809.4.5 Required capacity: The minimum required discharge capacity of the pressure-relief device or fusible plug for each pressure vessel shall be determined by the following formula:

$$C = fDL$$

Where C = minimum required discharge capacity of the relief device in lb. of air per min.

D = outside diameter of the vessel in ft.

L = length of the vessel in ft.

f = factor dependent upon kind of refrigerant, as shown in the following Table M-809.4.5.

When one (1) pressure-relief device or fusible plug is used to protect more than one (1) pressure vessel, the required capacity shall be the sum of the capacities required for each pressure vessel.

Table M-809.4.5

REFRIGERANT "F" VALUES

Kind of refrigerant	Value of f
Ammonia (Refrigerant 717)	0.5
Refrigerants 12, 22 and 500	1.6
Refrigerant 502 and Refrigerants 13, 13B1, and 14 when on cascaded systems	2.5
All other refrigerants	1.0

M-809.4.6 The rated discharge capacity of a pressure-relief valve, expressed in pounds of air per minute, shall be determined in accordance with Paragraph UG-131, Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code listed in Appendix B. All pipe and fittings between the pressure-relief valve and the parts of the system it protects shall have at least the area of the pressure-relief valve inlet.

M-809.4.7 The rated discharge capacity of a rupture member or fusible plug discharging to atmosphere under critical flow conditions in pounds of air per minute shall be determined by the following formulas:

$$C = 0.8\,P_1 d^2$$

$$d = 1.12\sqrt{\frac{C}{P_1}}$$

Where C = rated discharge capacity, in lbs. of air per min.
d = smallest of the internal diameter of the inlet pipe, retaining flanges, fusible plug or rupture member in inches.

Where for rupture members:
P_1 = (rated pressure × 1.10) + 14.7

For fusible plugs:
P_1 = absolute saturation pressure, corresponding to the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller, psia.

M-809.4.8 Discharge of pressure-relief devices and fusible plugs on all systems containing more than six (6) pounds of Group 2 or Group 3 refrigerant shall be to the outside of the building in an approved manner. Discharge of pressure-relief devices and fusible plugs on all systems containing more than one hundred (100) pounds of Group 1 refrigerants, unless installed in a machinery room not used for any purpose other than to house mechanical equipment and complying with the provisions as specified in Section M-810.12, shall be to the outside of the building. Discharge piping connected to the discharge side of a fusible plug or bursting disc shall have provisions to prevent plugging the piping in the event the fusible plug or bursting disc functions.

M-809.4.8.1 Pressure-relief valves may discharge into the low side of the system, provided the pressure-relief devices are of a type not appreciably affected by back pressures and provided the low side of the system is equipped with pressure-relief devices. The relief devices on the low side of the system shall have sufficient capacity to protect the pressure vessels that are relieved into the low side of the system or to protect all pressure vessels on the low side of the system, whichever relieving capacity is the largest, as computed by the formula in Section M-809.4.5. Such low side pressure-relief devices shall be set in accordance with Section M-809.2.1 and vented to the outside of the building in accordance with Section M-809.4.8.

M-809.4.8.2 Ammonia discharge: Where ammonia is used, the discharge may be into a tank of water which shall not be used for any purpose except ammonia absorption. At least one (1) gallon of fresh water shall be provided for each pound of ammonia in the system. The water used shall be prevented from freezing without the use of salt or chemicals. The tank shall be substantially constructed of not less than one-eighth (⅛) inch or No. 11 Manufacturers' Standard Gage (0.120 inch) iron or steel. Horizontal dimension of the tank shall not be greater than one-half (½) the height. The tank shall have hinged cover, or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure-relief valves shall discharge the ammonia in the center of the tank near the bottom.

M-809.4.8.3 Sulphur dioxide discharge: Where sulphur dioxide is used, the discharge may be into a tank of absorptive brine which shall not be used for any purpose except sulphur dioxide absorption. There shall be one (1) gallon of standard dichromate brine (two and one-half [2½] pounds sodium dichromate per gallon of water) for each pound of sulphur dioxide in the system. Brines made with caustic soda or soda ash may be used in place of sodium dichromate, provided the quanity and strength give the equivalent sulphur dioxide absorbing power. The tank shall be substantially constructed of not less than one-eighth (⅛) inch or No. 11 Manufacturers' Standard Gage (0.120 inch) iron or steel. The tank shall have a hinged cover, or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure-relief valve shall discharge the sulphur dioxide in the center of the tank near the bottom.

M-809.4.8.4 The size of the discharge pipe from the pressure-relief device or fusible plug shall not be less than the size of the pressure-relief device or fusible plug outlet. The discharge from more than one (1) relief device or fusible plug may be run into a common header, the area of which shall be not less than the sum of the areas of the pipes connected thereto.

M-809.4.8.5 The length of the discharge piping permitted to be installed on the outlet of a pressure-relief device or fusible plug shall be determined according to the following formulas:

$$C = \frac{3\,P\,d^{5/2}}{L^{1/2}}$$

$$d = \sqrt[5]{\frac{C^2 L}{9P^2}}$$

Where C = minimum required discharge capacity, in lb. of air per min.
d = internal diameter of pipe in in.

L = length of discharge pipe in ft.
P = $0.25P_1$ (P_1 is defined in Section M-809.4.7)

(See Table M-809.4.8.5 for computations derived from the preceding formula.)

M-809.4.9 Pressure-relief devices for positive displacement compressors: Positive displacement compressors operating above fifteen (15) pounds per square inch gauge (psig) and having a displacement exceeding fifty (50) cubic feet per minute shall be equipped by the manufacturer with a pressure-relief device of adequate size and pressure setting to prevent

Table M-809.4.8.5

LENGTH OF DISCHARGE PIPING FOR PRESSURE-RELIEF DEVICES OF VARIOUS DISCHARGE CAPACITIES

Equiv. length of discharge pipe, ft.	Discharge capacity in lb of air per min (C) standard wall iron pipe sizes, inches							
(L)	½	¾	1	1¼	1½	2	2½	3
	Relief set at 25 psia (P_1)							
50	0.81	1.6	2.9	5.9	8.7	16.3	25.3	43.8
75	0.67	1.4	2.4	4.9	7.2	13.3	20.9	35.8
100	0.58	1.2	2.1	4.2	6.2	11.5	18.0	30.9
150	0.47	0.95	1.7	3.4	5.0	9.4	14.6	25.3
200	0.41	0.8	1.5	2.9	4.4	8.1	12.6	21.8
300	0.33	0.67	1.2	2.4	3.6	6.6	10.5	17.9
	Relief set at 50 psia (P_1)							
50	1.6	3.3	5.9	11.9	17.4	32.5	50.6	87.6
75	1.3	2.7	4.9	9.7	14.3	26.5	41.8	71.5
100	1.2	2.3	4.2	8.4	12.3	23.0	36.0	61.7
150	0.94	1.9	3.5	6.9	10.0	18.7	29.2	50.6
200	0.81	1.6	2.9	5.9	8.7	16.3	25.3	43.7
300	0.66	1.3	2.5	4.9	7.1	13.3	21.0	35.7
	Relief set at 75 psia (P_1)							
50	2.4	4.9	8.9	17.9	26.1	48.7	75.9	131.5
75	2.0	4.1	7.3	14.6	21.4	39.8	62.6	107.0
100	1.7	3.5	6.4	12.6	18.5	34.4	54.0	92.6
150	1.4	2.8	5.2	10.3	15.0	28.0	43.8	75.9
200	1.2	2.5	4.4	8.9	13.1	24.4	37.9	65.6
300	0.9	2.0	3.7	7.3	10.7	19.9	31.5	53.5
	Relief set at 100 psia (P_1)							
50	3.2	6.6	11.9	23.8	34.8	65.0	101.2	175.2
75	2.7	5.4	9.7	19.4	28.6	53.0	83.6	143.0
100	2.3	4.6	8.5	16.8	24.6	45.9	72.0	123.6
150	1.9	3.8	6.9	13.7	20.0	37.4	58.4	101.2
200	1.6	3.3	5.9	11.9	17.5	32.5	50.6	87.6
300	1.3	2.7	4.9	9.7	14.2	26.5	42.0	71.4

Table M-809.4.8.5 (cont'd.)
LENGTH OF DISCHARGE PIPING FOR PRESSURE-RELIEF DEVICES OF VARIOUS DISCHARGE CAPACITIES

Relief set at 150 psia (P_1)								
50	4.9	9.9	17.9	35.7	52.3	97.5	151.8	262.8
75	4.0	8.1	14.6	29.2	42.9	79.5	125.4	214.5
100	3.5	6.9	12.7	25.2	36.9	68.9	108.0	185.4
150	2.8	5.7	10.4	20.6	30.0	56.1	87.6	151.8
200	2.4	4.9	8.9	17.8	26.2	48.7	75.9	131.4
300	1.9	4.0	7.4	14.6	21.1	39.7	63.0	107.1
Relief set at 200 psia (P_1)								
50	6.5	13.2	23.8	47.6	69.7	130.0	202.4	350.4
75	5.3	10.8	19.4	38.9	57.2	106.0	167.2	286.0
100	4.6	9.2	16.9	33.6	49.2	91.8	144.0	247.2
150	3.8	7.6	13.8	27.4	40.0	74.8	116.8	202.4
200	3.2	6.5	11.8	23.8	34.9	64.9	101.2	175.2
300	2.6	5.3	9.8	19.4	28.4	52.9	84.0	142.8
Relief set at 250 psia (P_1)								
50	8.1	16.5	29.8	59.5	87.1	162.5	253.0	437.0
75	6.7	13.5	24.3	48.6	71.5	132.5	209.0	357.5
100	5.8	11.6	21.2	42.0	61.6	114.8	180.0	309.0
150	4.7	9.5	17.3	34.3	50.0	93.5	146.0	253.0
200	4.1	8.2	14.8	29.7	43.7	81.2	126.5	219.0
300	3.3	6.7	12.3	24.3	35.5	66.2	105.0	178.5
Relief set at 300 psia (P_1)								
50	9.7	19.8	35.7	71.4	104.5	195.0	303.6	525.6
75	7.9	16.2	29.1	58.3	85.8	159.0	250.8	429.0
100	6.9	13.9	25.4	50.4	73.9	137.7	216.0	370.8
150	5.6	11.3	20.7	41.1	60.0	112.2	175.2	303.6
200	1.9	9.8	17.8	35.6	52.4	97.4	151.8	262.8

rupture of the compressor, located between the compressor and stop valve on the discharge side. The discharge from such pressure-relief device may be vented to the atmosphere or into the low pressure side of the system.

SECTION M-810.0 INSTALLATION REQUIREMENTS

M-810.1 General: Foundation and supports for condensing units or compressor units shall be of substantial and noncombustible construction when more than six (6) inches high.

M-810.1.1 Installation in windows or other wall openings: Refrigerating systems or units installed in windows, transoms or other such wall openings shall rest upon building members of sufficient strength to safely support their weight. Such units or systems shall be adequately supported by metal brackets securely anchored or attached to the building. The brackets exposed to weather shall be of suitable design to withstand corrosion for a prolonged period. Bracket attachments or anchors shall be so located as to be readily accessible for inspection, terminating within the building if necessary to meet this requirement. A refrigerating system or unit shall not extend beyond the building in such a manner as to create a hazard to pedestrian or vehicular traffic or encroach into a required yard.

M-810.1.2 Roof-mounted equipment: Refrigerating systems or units, not exceeding four hundred (400) pounds in total weight and installed on the roofs of buildings, shall be supported by at least two (2) structural members of sufficient strength spanning at least four (4) wood joists, or three (3) steel joists or two (2) trusses of a roof system properly designed to support its own dead weight and a live load of not less than thirty (30) pounds per square foot (psf). Such equipment and supporting members shall be adequately secured to the joists or trusses of the roof system, and the roof deck shall be made water-tight after such anchorage system is completed. The location of the equipment shall be limited to the first one-fourth (¼) distance from any bearing wall. Equipment installed so as to exceed the weight, placement or roof strength requirements specified in this section shall meet the requirements of the department, including the obtaining of the necessary building permits.

M-810.2 Moving machinery: Moving machinery shall be guarded in accordance with approved safety standards as listed in Appendix B.

M-810.3 Accessibility: Condensing units or compressor units shall be readily accessible for servicing and inspection.

M-810.3.1 Accessibility of equipment: Where refrigeration equipment is installed in relatively inaccessible locations such as roofs, crawl spaces, attics, furred spaces and similar areas, means shall be provided for gaining safe approach and access to such equipment for servicing and inspection. Portable ladders shall not be over twenty (20) feet long with at least three (3) rungs projecting above the roof, parapet, platform or other means of support. Stationary ladders over twenty (20) feet high shall be provided with proper loops or guards above the twenty (20) foot level. Stairways shall be provided with handrails. All ladders and stairways shall be of substantial construction. Openings in building construction to the equipment shall be at least twenty-four (24) inches by thirty-six (36) inches in size. Trap doors shall be properly hinged and counterweighted. An unobstructed passageway, not less than three (3) feet high, with solid flooring at least two (2) feet in width, shall be provided to the equipment. All parts of the equipment shall be accessible for inspection and servicing. Solid flooring, measuring at least thirty (30) inches out from the equipment, with at least three (3) feet of headroom provided, shall be furnished around the equipment. Adequate lighting shall be provided at the equipment. The switch controlling the electric light and a disconnect switch for the equipment shall be installed in a readily accessible location remote from the equipment area or the approach area, if necessary to meet this requirement.

M-810.4 Water supply and discharge connections shall be made in accordance with approved safety and health standards listed in Appendix B.

M-810.4.1 Discharge water lines shall not be directly connected to the waste or sewer systems. The waste or discharge from such equipment shall be through an approved air gap to a trapped and vented plumbing fixture.

M-810.4.1.1 Valves on water connections: When municipal water is connected to any refrigerant-containing component of a refrigerating system (e.g. shell-and-tube condensers, double-pipe condensers, water-jacketed compressor cylinders, etc.) in such a way that there would be direct contact between city water and the refrigerant upon leakage through the wall separating the two (2) fluids, the following provisions shall apply:

1. the water control valve, either manually or automatically operated, shall be located on the inlet side of the refrigerant-containing component; and
2. there shall not be an automatically or manually operated water shut-off valve in the discharge piping from the refrigerant-containing component, except where two (2) or more components are served in parallel from a common water supply line, provided a check valve is installed upstream from all supply connections.

M-810.5 Illumination adequate for inspection and servicing of condensing units or compressor units shall be as provided in American National Standard A11.1 for Industrial Lighting listed in Appendix B.

M-810.6 Electrical equipment and wiring shall be installed in accordance with the electrical code of this jurisdiction.

M-810.7 Gas fuel devices and equipment used with refrigerating systems shall be installed in accordance with this code and the National Fire Protection Association Standards Nos. 37 and 54 listed in Appendix B.

M-810.8 Air duct systems of air-conditioning equipment for human comfort using mechanical refrigeration shall be installed in accordance with this code and the National Fire Protection Association Standards Nos. 90-A and 90-B listed in Appendix B.

M-810.8.1 Air ducts passing through a Class T machinery room shall be of tight construction and shall not have openings in such rooms.

M-810.9 Joints and refrigerant-containing parts in air ducts: Joints and all refrigerant-containing parts of a refrigerating system located in an air duct carrying conditioned air to and from a humanly occupied space shall be constructed to withstand a temperature of seven hundred (700) degrees F. without leakage into the air stream.

M-810.10 Exposure of refrigerant pipe joints: Refrigerant pipe joints erected on the premises shall be exposed to view for visual inspection prior to being covered or enclosed.

M-810.11 Location of refrigerant piping

M-810.11.1 Refrigerant piping crossing on open space which affords passageway in any building shall not be less than seven and one-half (7½) feet above the floor unless against the ceiling of such space.

M-810.11.2 Free passageway shall not be obstructed by refrigerant piping. Refrigerant piping shall not be placed in any elevator, dumbwaiter, or other shaft containing a moving object, or in any shaft which has openings to living quarters or to main exit hallways. Refrigerant piping shall not be placed in public hallways, lobbies or stairways, except that such refrigerant piping may pass across a public hallway if there are not joints in the section in the public hallway, and provided nonferrous tubing of one and one-eighth inch (1⅛) outside diameter and smaller be contained in a rigid metal pipe.

M-810.11.3 Refrigerant piping shall not be installed vertically through floors from one story to another, except as follows.

1. It may be installed from the basement to the first floor, or from the top floor to a machinery penthouse or to the roof.
2. For the purpose of interconnecting separate pieces of equipment not located on adjacent stories, the piping may be carried through intermediate stories in an approved rigid and tight continuous noncombustible pipe, duct or shaft not having openings into the intermediate stories, or it may be carried on the outer wall of the building provided it is not located in an air shaft, closed court or in other similar spaces enclosed within the outer walls of the building. The pipe duct or shaft shall be vented to the outside.
3. Piping of direct systems containing Group 1 refrigerant, as governed by Section M-805.2.1, need not be enclosed where it passes through space served by that system.

M-810.11.4 Refrigerant piping may be installed horizontally in closed floors or in open joist spaces. Piping installed in concrete floors shall be encased in pipe duct.

M-810.12 Refrigerant machinery room requirements

M-810.12.1 Each refrigerant machinery room shall be provided with tight-fitting door or doors and shall not have partitions or openings that will permit the passage of escaping refrigerant to other parts of the building.

M-810.12.2 Each refrigerating machinery room shall be provided with means for ventilation to the outer air. The ventilation shall consist of windows or doors opening to the outer air, of the size shown in Table M-810.12.2, or of mechanical means capable of removing the air from the room in accordance with Table M-810.12.2. The amount of ventilation for refrigerant removal purposes shall be determined by the refrigerant content of the largest system in the machinery room.

M-810.12.3 Air supply and return ducts used for machinery room ventilation shall not serve other areas.

M-810.12.4 Mechanical ventilation, when used, shall consist of one (1) or more power-driven exhaust fans which shall be capable of removing from the refrigerating machinery room the amount of air specified in Table M-810.12.2. The inlet to the fan, or fans, or air duct connection shall be located near the refrigerating equipment. The outlet from the fan, or fans, or air duct connections shall terminate outside of the building in an approved manner. When air ducts are used either on the inlet or discharge side of the fan, or fans, they shall have an area not less than specified in Table M-810.12.2. Provision shall be made for the inlet of air to replace that being exhausted.

M-810.12.5 Machinery room, Class T, shall not have flame-producing apparatus permanently installed, and operated and also shall conform to the following requirements listed below.

1. Any doors, communicating with the building, shall be approved self-closing, tight-fitting fire doors.
2. Walls, floor, and ceiling shall be tight and of not less than one (1) hour fireresistance-rated construction.
3. It shall have an exit door which opens directly to the outer air or through a vestibule-type exit equipped with self-closing, tight-fitting doors.
4. Exterior openings, if present, shall not be under any fire escape or any open stairway.
5. All pipes piercing the interior walls, ceiling or floor of such room shall be tightly sealed to the walls, ceiling or floor through which they pass.
6. Emergency remote controls to stop the action of the refrigerant compressor shall be provided and located immediately outside the machinery room.
7. An independent mechanical ventilation system shall be provided and operated continuously.
8. Emergency remote controls for the mechanical means of ventilation shall be provided and located outside the machinery room.

SECTION M-811.0 FIELD TESTS

M-811.1 General: Every refrigerant-containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gauges, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation and before operation. The high or low side of each system

Table M-810.12.2

MINIMUM AIR DUCT AREAS AND OPENINGS

	Weight of refrigerant in system, lbs.	Mechanical discharge of air, cfm	Duct area, sq. ft.	Open areas of windows and doors, sq. ft.
up to	20	150	¼	4
	50	250	⅓	6
	100	400	½	10
	150	550	⅔	12½
	200	680	⅔	14
	250	800	1	15
	300	900	1	17
	400	1,100	1¼	20
	500	1,275	1¼	22
	600	1,450	1½	24
	700	1,630	1½	26
	800	1,800	2	28
	900	1,950	2	30
	1,000	2,050	2	31
	1,250	2,250	2¼	33
	1,500	2,500	2¼	37
	1,750	2,700	2¼	38
	2,000	2,900	2¼	40
	2,500	3,300	2½	43
	3,000	3,700	3	48
	4,000	4,600	3¾	55
	5,000	5,500	4½	62
	6,000	6,300	5	68
	7,000	7,200	5½	74
	8,000	8,000	5¾	80
	9,000	8,700	6¼	85
	10,000	9,500	6½	90
	12,000	10,900	7	100
	14,000	12,200	7½	109
	16,000	13,300	7¾	118
	18,000	14,300	8	125
	20,000	15,200	8¼	130
	25,000	17,000	8¾	140
	30,000	18,200	9	145
	35,000	19,400	9¼	150
	40,000	20,500	9½	155
	45,000	21,500	9¾	160

shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except as noted in Section M-811.1.1.

M-811.1.1. Systems erected on the premises using Group 1 refrigerant and with copper tubing not exceeding five-eighth (⅝) inch outside diameter may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at seventy (70) degrees F. minimum.

M-811.2 **Test medium:** Oxygen or any combustible gas or combustible mixture of gases shall not be used within the system for testing.

M-811.2.1 The means used to build up the test pressure shall have either a pressure-limiting device or a pressure reducing device with a pressure-relief device and a gauge on the outlet side. The pressure-relief device shall be set above the test pressure but shall be low enough to prevent permanent deformation of the system components.

M-811.3 A dated declaration of test shall be provided for all systems containing fifty (50) pounds or more of refrigerant. The declaration shall give the name of the refrigerant and the field test pressure applied to the high side and the low side of the system. The declaration of test shall be signed by the installer and, if an inspector is present at the tests, he shall also sign the declaration. When requested, copies of this declaration shall be furnished to the administrative authority.

SECTION M-812.0 GENERAL REQUIREMENTS

M-812.1 **Signs:** Each refrigerating system erected on the premises shall be provided with a legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations and the field test pressure applied.

M-812.1.1. **Metal signs for systems containing more than 100 pounds of refrigerant:** Systems containing more than one hundred (100) pounds of refrigerant shall be provided with metal signs having letters not less than one-half (½) inch in height designating the main shut-off valves to each vessel, main steam or electrical control, remote control switch and pressure-limiting device. On all exposed high pressure and low pressure piping in each room where installed outside the machinery room shall be signs, as specified above, with the name of the refrigerant and the letters *HP* or *LP*.

M-812.1.2. When the kind of refrigerant is changed, as provided in Section M-812.2, there shall be a new sign, of the same type as specified in M-812.1.1., indicating clearly that a substitution has been made and stating the same information for the new refrigerant as was stated in the original.

M-812.2 **Refrigerant substitution:** Substitution of kind of refrigerant in a system shall not be made without the permission of the administrative authority, the user, and the makers of the original equipment, and with due observance of safety requirements, including:

1. the effects of the substituted refrigerant on materials in the system;

2. the possibility of overloading the liquid receiver which should not be more than eighty (80) per cent full of liquid;
3. the liability of exceeding motor horsepower, design working pressure or any other element that would violate any of the provisions of this article;
4. the proper size of refrigerant controls;
5. the effect on the operation and setting of safety devices;
6. the possible hazards created by mixture of the original and substituted refrigerant; and
7. effect of the classification of the refrigerant as provided in this article.

M-812.3 Charging and discharging refrigerants: When refrigerant is added to a system, except a unit system, requiring less than six (6) pounds of refrigerant, it shall be charged into the low pressure side of the system. Any point of the downstream side of the main liquid line stop valve shall be considered as part of the low pressure side when operating with said stop valve in the closed position. The service container shall not be left connected to a system except while charging or withdrawing refrigerant.

M-812.3.1 Refrigerants withdrawn from refrigerating systems shall be transferred to containers conforming to the Interstate Commerce Commission regulations listed in Appendix B. A refrigerant shall not be discharged to a sewer.

M-812.3.2 Containers used for refrigerants withdrawn from a refrigerating system shall be carefully weighed each time they are used for this purpose, and the containers shall not be filled in excess of the permissible filling weight for such containers and such refrigerants as are prescribed in the pertinent regulations of the Interstate Commerce Commission listed in Appendix B.

M-812.4 Machinery room storage: Refrigerant stored in a machinery room shall not be more than twenty (20) per cent of the normal refrigerant charged nor more than three hundred (300) pounds of the refrigerant, in addition to the charge in the system and the refrigerant stored in a permanently attached receiver, and then only in approved storage containers.

M-812.5 Masks or helmets: At least two (2) masks or helmets shall be provided at a location convenient to the machinery room when the amount of a Group 2 refrigerant exceeds one hundred (100) pounds.

M-812.5.1 Only complete helmets or masks marked as approved by the Bureau of Mines of the United States Department of the Interior and suitable for the refrigerant employed shall be used, and they shall be kept in a suitable cabinet immediately outside the machinery room or other approved accessible location.

M-812.5.2 Canisters or cartridges of helmets or masks shall be renewed immediately after having been used or the seal broken and, if unused, the canisters shall be renewed not later than the date noted on the canister labels.

M-812.6 **Maintenance:** All refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste and other debris and shall be kept readily accessible at all times.

M-812.7 **Responsibility as to operation of the system:** It shall be the duty of the person in charge of the premises on which a refrigerating system containing more than fifty (50) pounds of refrigerant is installed to place a card conspicuously as near as practicable to the refrigerant compressor giving directions for the operation of the system, including precautions to be observed in case of a breakdown or leak as follows:

1. instruction for shutting down the system in case of emergency;
2. the name, address, and day and night telephone numbers for obtaining service; and
3. the name, address, and telephone number of the inspection department having jurisdiction, and instructions to notify said department immediately in case of emergency.

M-812.8: Pressure gauges should be checked for accuracy prior to test and immediately after every occasion of unusually high pressure, equal to full scale reading either by comparison with master gauges or by setting the pointer as determined by a dead weight pressure gauge tester.

ARTICLE 9

INCINERATORS, CREMATORIES, FIREPLACES AND BARBECUES

SECTION M-900.0 GENERAL

M-900.1 Scope: The requirements of this article shall govern the installation, repair, maintenance and approval of all incinerators, crematories, fireplaces and barbecues. For purposes of this code, barbeques shall be considered fireplaces and shall meet all the requirements of same.

M-900.2 Plans: Plans shall be submitted for approval in accordance with the building code of this jurisdiction.

M-900.3 Annual inspection: All crematories and all incinerators, except Class I, Class IA and domestic, shall be inspected annually by the department. Fee for such inspection shall be as follows: [*amount*] per incinerator or crematory.

M-900.4 Location of incinerators: All outside incinerators shall be so placed that they will not constitute a fire hazard to adjacent buildings or structures. Also see the zoning ordinance of this jurisdiction.

M-900.5 Locations prohibited: Installation of any type incinerator, barbecue (fixed or portable) or fireplace in garages or in areas containing explosive or flammable liquids or fumes is expressly prohibited unless separated therefrom by at least a four (4) hour fireresistance rated separation without any openings to the areas specified above.

M-900.6 Existing incinerators: All existing incinerators shall be made to comply with the provisions of this article where practicable.

M-900.7 Trash chute charging doors: Trash chute charging doors shall be of an approved type, self-closing and locking, and shall have a one (1) hour fireresistance rating.

M-900.8 Trash chute vent: All trash chutes shall be vented to the outside in an approved manner.

M-900.9 Trash chute opening: The opening of a trash chute into the trash room shall be protected by a counter-balanced self-closing door held open by a one hundred thirty-five (135) degree F. fusible link or other approved device. This door shall be in a normally open position.

SECTION M-901.0 DOMESTIC GAS-FIRED INCINERATORS

M-901.1 General: This section shall apply to approved gas-fired, free-standing incinerators with a loading capacity of not more than five (5) cubic feet.

M-901.1.1. Clearance to permit access and servicing of the unit shall be provided.

M-901.1.2 All new and existing domestic gas-fired incinerators must meet the smokeless and odorless requirements of ANSI Z. 21.6 listed in Appendix B.

M-901.1.3 Incinerators shall be mounted or set on masonry floors.

> **Exception:** Incinerators approved for installation on combustible floors may be installed in accordance with the conditions of such approval.

M-901.2 Clearance: Incinerators shall have a clearance to combustible material of at least twelve (12) inches at sides and rear, and at least thirty (30) inches at front and thirty-six (36) inches above.

> **Exceptions**
>
> 1. Incinerators approved for installation with a lesser clearance than herein specified may be installed in accordance with the conditions of such approval.
> 2. Clearance shall not be required when of masonry construction of four (4) inches or more thickness except on the service side where the clearance shall be at least thirty (30) inches.

M-901.3 Ventilation: When an incinerator is installed in a confined area, and air is supplied from ventilated adjacent areas to the room housing the incinerator, two (2) openings, one (1) near the floor and one (1) near the ceiling, each with a minimum net free area of one hundred (100) square inches shall be provided in the room door or walls.

M-901.3.1 When adjacent areas do not have sufficient air infiltration, air shall be supplied from outdoors directly to the room housing the incinerator through an opening or openings with a total net free area of one hundred (100) square inches.

SECTION M-902.0 COMMERCIAL AND INDUSTRIAL INCINERATORS

M-902.1 General

M-902.1.1. Location: Inside incinerators and the waste material bins or containers shall be located either in a room or compartment not used for any other purpose or in a room devoted exclusively to boilers or a heating plant. In either case, such room shall be separated from the balance of the building by two (2) hour fireresistance rated walls, floors and ceilings with all openings equipped with one and one-half (1½) hour fireresistance rated doors and provided with approved self-closing devices.

> **Exception:** In H (high hazard), S (storage), M (mercantile), F (factory and industrial), B (business), R-1 (hotels), and R-2 (multifamily dwellings) group occupancies, a one (1) hour fireresistance rated separation shall be provided.

M-902.1.2 Incinerator room isolation: Natural draft incinerators shall be completely isolated from the effect of any air conditioning system, boiler room induced draft system or any other ventilating system.

M-902.1.3 Sprinklers: Every incinerator room shall be provided with fire sprinklers as required in Article 10, except when the incinerator burns only Type 4 waste and is approved by the department and the fire department.

M-902.1.4 Egress: Two (2) means of egress shall be provided when incinerator rooms are more than three hundred (300) square feet in floor area. These egress requirements of an incinerator room shall also apply when an incinerator is located in a boiler or a furnace room.

M-902.1.5 Ventilation: Ventilation shall be provided in accordance with the requirements of Article 3.

M-902.1.6 Incinerator for combination waste: Any incinerator which is designed to burn a combination of wastes and where such combination does not fall into the category of the "Classification of incinerators" as set forth in Section M-902.7, the incinerator shall be Class VI or Class VII. In the design, the specific wastes shall be classified into the standard categories for such wastes, and the portion of the incinerator chamber burning this waste shall conform to the minimum and maximum set forth for that category. The total products of combustion and the total heat release and burner capacities shall be used in determining the sizes of the down pass, final combustion chamber, flue connection and stack.

M-902.1.7 Pathological incinerators: When Type 4 waste is included in mixed waste, the department may determine the need for a pathological incinerator.

M-902.1.8 Operating instructions: The incinerator operator shall follow the written instructions of the manufacturer. One (1) copy of the instructions shall be furnished to the deparment, and one (1) copy shall be protected from soiling and posted in the incinerator room.

M-902.1.9 Name plate: A name plate shall be conspicuously fastened to the incinerator indicating the manufacturer's name, model number, rated capacity of the unit, the type of waste for which it is designed and date installed.

M-902.1.10 Scrubbers: Alkaline scrubbers, or other approved devices, shall be required for incinerators burning halogenated compounds.

M-902.1.11 Emissions: The type of waste for which the incinerator was designed shall be burned in such a manner that the emissions meet the requirements of Article 11.

M-902.1.12 Prohibited installations: In-line incinerators with a burning capacity less than seven hundred fifty (750) pounds per hour shall not be installed.

> **Exception:** In existing buildings, where space is not available for a retort-type incinerator, in-line incinerators may be installed when approved by the department.

M-902.2 Design: Incinerators shall be designed in accordance with the requirements of this section.

M-902.2.1 Incinerator volume: The interior incinerator volume shall be calculated by measuring the inside distance between the side walls, and from the front end to the rear wall and from paving to roof, excluding ash pit, interior walls, grates and hearth. Door openings, chutes or charging hoods or flue connections shall not be considered a part of the incinerator volume. The volume of the charging door opening, through which the refuse is placed in the incinerator, may be considered a part of the furnace volume. Roof height above the grate shall not be less than four-thirds (4/3) of the grate area to the power of four-elevenths ($Ag^{4/11}$) plus or minus ten (10) per cent, except Class VI incinerator. Total heat release in the entire incinerator shall not exceed twenty-five thousand (25,000) Btus per cubic foot per hour.

M-902.2.2 Settling chamber: A chamber shall be provided in which the products of combustion are reduced in velocity to nine (9) feet per second at fourteen hundred (1400) degrees F. while traveling in a vertical direction. The length of gas travel at nine (9) feet per second shall be a distance at least the square root of the horizontal cross-sectional area of the settling chamber, measured from the top of the opening under the curtain wall to the roof of the incinerator, or to the top of the breeching connection, whichever is lower.

M-902.2.3 Flame port: The flame port shall be designed to provide a velocity of not less than fifty (50) feet per second calculated at one thousand (1,000) degrees F.

> **Exception:** Domestic gas-fired, Class I and Class IA.

M-902.2.4 Down pass: All incinerators, except gas-fired domestic, shall include a down pass and/or other means of creating turbulence for the gases of combustion to assure thorough mixing of the gases prior to their entering the secondary combustion chamber.

M-902.2.5 Refractory lining

M-902.2.5.1 Refractory lining four and one-half (4½) inches in thickness shall be required except where the area of any wall exceeds thirty-five (35) square feet. Every wall over four (4) feet in height shall be anchored every four (4) feet. Castable and/or plastic refractory shall be anchored every eighteen (18) inches.

M-902.2.5.2 Where the area specified in Section M-902.2.5.1 is exceeded, the lining of all walls and the roof shall be of at least nine (9) inches in thickness.

M-902.2.5.3 Walls of greater thickness may be required by the department to provide structural stability.

M-902.2.6 Roofs, arches and lintels: All roofs or arches shall be so designed that metal supports or lintels are not directly exposed to heat or flame.

M-902.2.7 Barometric damper: A barometric damper shall be provided, and for natural draft stacks, its free area shall be at least the percentage of the cross-sectional area of the flue connections, breeching or stack in which it is located as indicated in Table M-902.2.7.

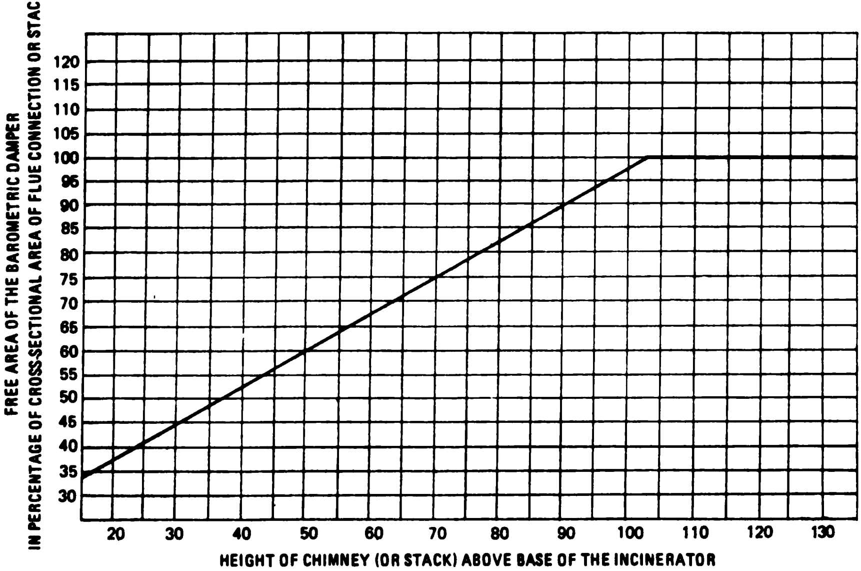
M-902.2.8 Dampers

M-902.2.8.1 All incinerators shall be provided with a guillotine or slid-

Table M-902.2.7

USE TO DETERMINE FREE AREA OF BAROMETRIC DAMPERS

(For natural draft stacks only)



ing damper. Design criteria shall provide at least ten (10) per cent free opening when the damper is in the fully closed position.

M-902.2.8.2 Guillotine dampers provided for draft regulation shall be properly counter-balanced, and sliding dampers shall be arranged for easy operation. The dampers shall be constructed of a steel frame with refractory lining or may be constructed entirely of alloy steel to withstand the high temperature. All such dampers shall be provided with a damper box constructed of No. 12 Manufacturers' Standard Gage (0.105 inch) steel to completely house the damper when in its full open position. All guillotine and sliding dampers shall be provided with an approved locking device.

M-902.2.9 Mortar: All refractory brick shall be laid in high temperature air-setting refractory mortar (ASTM C64). Such mortar shall be for the same service as the refractory brick.

M-902.2.10 Metal casing: A metal casing shall be required for all incinerators.

M-902.2.11 Insulation: Insulation shall not be less than two (2) inches in thickness but shall provide a shell temperature not in excess of ninety (90) degrees F. after the incinerator is fired for the maximum time normal to the user's operation but shall not exceed a temperature of one hundred eighty (180) degrees F.

M-902.2.12 Refuse charging: Refuse charging may be direct, side, end or top. However, the charging chutes shall not exceed six (6) feet in length measured from the floor opening above the incinerator to the outside roof of the incinerator. The charging chute shall be constructed of at least No. 12 Manufacturers' Standard Gage (0.105 inch) steel casing, lined with at least four and one-half (4½) inches of refractory. Where the incinerator is top charged, an induced draft fan shall be provided.

M-902.2.13 Combustion air: Air for combustion shall be calculated at fifteen (15) pounds for ten thousand (10,000) Btus total heat release, based on the theoretical air required for complete combustion of liquid and solid fuels of seven (7) to seven and one-half (7½) pounds of air per ten thousand (10,000) Btus in such fuels.

M-902.2.14 Underfire air: Underfire air shall not exceed ten (10) per cent of the total air.

M-902.3 Chimney termination (height): Unless otherwise required in Article 7, every incinerator chimney, except those for domestic gas-fired incinerators, shall extend above the roof as follows:

1. natural draft chimneys shall extend at least eight (8) feet above the roof and not less than two (2) feet above the elevation of any part of the building within twenty (20) feet of the chimney;
2. chimneys serving incinerators provided with induced draft shall extend at least three (3) feet above the roof and above the ele-

Incinerator capacity in lbs. per hour	Class III incinerators						Class IV incinerators			Class VI incinerators		
	Type 1 waste			Type 2 waste			Type 3 waste			Type 4 waste		
	Air[a] supply	Stack		Air[a] supply	Stack		Air[a] supply	Stack		Air[a] supply	Stack	
		dia.	height[b]		dia.	height[b]		dia.	height[b]		dia.	height[b]
50										90	9″	30′
100	350	14″	35′	250	12″	30′	200	12″	35′	180	10″	30′
150	525	16″	35′	375	14″	35′	300	14″	35′	270	12″	30′
200	700	18″	45′	500	16″	35′	400	14″	45′	360	14″	30′
300	1050	20″	45′	750	18″	45′	600	16″	50′	540	16″	35′
400	1400	22″	50′	1000	20″	50′	800	18″	50′	720	18″	35′
500	1750	24″	50′	1250	22″	50′	1000	20″	55′	900	20″	35′
600	2100	26″	50′	1500	24″	50′	1200	22″	55′			
700	2450	28″	55′	1750	26″	55′	1400	24″	60′			
800	2800	30″	55′	2000	28″	55′	1600	26″	60′			
900	3150	32″	55′	2250	30″	55′	1800	28″	60′			
1000	3500	34″	55′	2500	32″	55′	2000	30″	60′			

Notes to Table M-902.3

Note a. Air supply is given in cfm at 70° F. and is the minimum which must be available at all times in the incinerator room at atmospheric or a slight positive pressure. The incinerator room or rooms should never be under a negative or minimum pressure. If the incinerator is charged from a room other than the incinerator room, the quantity of air shown must be available in both rooms.

The quantity of air shown must be increased to satisfy the following.

1. If stack or chimney is higher than minimum to satisfy the larger barometric damper involved.

2. If any other equipment requiring air supply is located in the incinerator room or charging room.

Note b. The stack heights are based on the following.

1. Installation made at or near 5000 feet above sea level.
2. Stack heights measured from the base of the incinerator.
3. Incinerator is side charged.
4. Breeching or flue connection not exceeding ten feet in length in a straight run or three feet including not more than 1-90° bend or 2-45° bends.
5. Stack extends as provided for in Section M-902.3.

The stack heights must be increased or may be decreased as follows.

1. Increase heights 5% per 1000 feet above sea level.
2. Decrease height 25% if stack is directly on top of incinerator eliminating any breeching or flue connection.
3. Increase height 15% if incinerator is top charged.
4. Increase height 15% for each additional ten feet of straight breeching and 15% for each additional 90° bend.

vation of any part of the building within twenty (20) feet of the chimney; and

3. when a taller obstruction is within one hundred (100) feet of the chimney, the chimney shall extend at least eight (8) feet above the highest part of the obstruction, unless an induced draft fan is installed.

M-902.3.1 Chimney casing: Incinerator chimneys erected within a building shall be encased in No. 10 Manufacturers' Standard Gage (0.135 inch) steel. All joints shall be tightly sealed.

M-902.3.2 Flue connections or breechings: Flue connections or breechings shall meet the requirements for stacks, except where flue gas temperature reduction is affected. The minimum for unlined breeching shall be No. 12 Manufacturers' Standard Gage (0.105 inch) Type 316 stainless steel with clearances as required in Article 7 for metal stacks.

M-902.3.3. Spark screen: A spark screen shall not be required when a gas washer is installed, unless a by-pass of the gas washer is incorporated.

M-902.3.4 Prohibition: Incinerators shall not be vented into a chimney or stack serving any other device, unless approved by the department.

Exception: Gas-fired domestic incinerators.

M-902.3.5 Combustion calculation: Table M-902.6 includes a column headed "Btu of aux. fuel per lb. of waste to be included in combustion calculations". The figures in this column shall be included when determining total heat release within the furnace and shall also be included, together with the theoretical air required for the fuel, when determining the total products of combustion. The figures in the column headed "Min. Btu/hr. burner input per lb. waste" shall be used to determine minimum capacity of the burner or burners. Secondary burners shall be sized to raise the products of combustion at least two hundred (200) degrees F. for Type 00, Type 0, Type 1 and Type 2 waste, and at least four hundred (400) degrees F. for waste containing over ten (10) per cent plastics, wax coated or impregnated paper or other dense smoke-producing materials.

M-902.3.6 Flue gas washers: Where flue gas washers are installed, a pressure switch and flow switch or thermocouple shall be interlocked with the gas supply to the main burner(s) to interrupt the gas supply in the event of water failure.

M-902.4 Burners: All burners for incinerators shall be power type, and the controls shall comply with the requirements of Article 6.

M-902.4.1 Secondary burners: All new incinerators shall provide for secondary burner(s) (see Section M-902.3.5). Primary burners shall be provided as required in Table M-902.6.

Table M-902.3.1

INDUCED DRAFT FANS

Incinerator capacity in lbs. per hour	Class III incinerators									
	Type 1 waste					Type 2 waste				
	Air** supply	Lbs. per hour		Fan		Air** supply	Lbs. per hour		Fan	
		Flue gases	Cooling air	Cfm at 700° F.	"Cold" s.p.		Flue gases	Cooling air	Cfm at 700° F.	"Cold" s.p.
100	850	1080	2160	1630	.7	600	768	1540	1130	.68
150	1275	1620	3240	2160	.7	900	1152	2310	1700	.7
200	1700	2160	4320	3260	.72	1200	1536	3080	2250	.7
300	2550	3240	6480	4320	.72	1800	2304	4610	3380	.72
400	3400	4320	8640	6520	.75	2400	3072	6150	4500	.75
500	4250	5400	10800	7580	.75	3000	3840	7680	5680	.75
600	5100	6480	12960	8640	.75	3600	4608	9220	6750	.75
700	5950	7560	15120	10840	.8	4200	5376	10750	7880	.8
800	6800	8640	17280	13040	.8	4800	6144	12290	9000	.8
900	7650	9720	19440	14100	.8	5400	6912	13830	10130	.8
1000	8500	10800	21600	15160	.8	6000	7680	15360	11250	.8
Incinerator capacity in lbs. per hour	Class IV incinerators					Class VI incinerators				
	Type 3 waste					Type 4 waste				
	Air** supply	Lbs. per hour		Fan		Air** supply	Lbs. per hour		Fan	
		Flue gases	Cooling air	Cfm at 700° F.	"Cold" s.p.		Flue gases	Cooling air	Cfm at 700° F.	"Cold" s.p.
50						200	262	525	385	.68
100	485	625	1250	920	.7	400	523	1050	770	.68
150	728	938	1875	1380	.7	600	785	1570	1155	.68
200	970	1250	2500	1840	.72	800	1046	2100	1540	.68
300	1455	1875	3750	2760	.75	1200	1569	3050	2310	.7
400	1940	2500	5000	3680	.75	1600	2092	4200	3080	.7
500	2425	3125	6250	4600	.8	2000	2615	5250	3850	.7
600	2910	3750	7500	5520	.8					
700	3395	4375	8750	6440	.85					
800	3880	5000	9000	7360	.85					
900	4365	5625	10250	8280	.85					
1000	4850	6250	12500	9200	.85					

**Air supply is given in cfm at 70° F. and is the minimum which shall be available at all times in the incinerator room for combustion and fan cooling air. See also notes regarding "air supply" Table M-902.3.

Note a. The total flue gases or total products of combustion are given in lbs. per hour.

Note b. The cooling air is given in lbs. per hour and is the air required to be bled into and mixed with the flue gases before entering the induced draft fan and unlined breeching section.

Note c. The fan capacity is given in cfm at 700° F. which is anticipated temperature of the air-gas mixture entering the induced draft fan.

Note d. The static pressure of the fan is given as the "cold" (70° F.) static pressure and with the installation made at or near sea level. The static pressure at 700° F. is 45% of the "cold" static pressure. Increase the "cold" static pressure 3.5% for every 1000 feet above sea level.

Note e. Water sprays or a combination of water and air may be used to cool the flue gases before they enter the fan. The cfm of the fan reduces, but the static pressure of the fan increases, to overcome the resistance created by the gas washer or scrubber used.

Table M-902.3.5

CALCULATIONS
PRODUCTS OF COMBUSTION FURNACE VOLUMES

Type 0 waste	Type 1 waste	Type 2 waste
$\frac{1 \times 15 \times 8500}{10{,}000}$ = 12.75 lbs. of air	$\frac{1 \times 15 \times 6500}{10{,}000}$ = 9.75 lbs. of air	$\frac{1 \times 15 \times 4300}{10{,}000}$ = 6.45 lbs. of air
1 × .85 = 0.85 lbs. of combustibles	1 × .65 = 0.65 lbs. of combustibles	1 × .43 = 0.43 lbs. of combustibles
1 × .10 × 1.6 = 0.16 lbs. of water vapor	1 × .25 × 1.6 = 0.40 lbs. of water vapor	1 × .50 × 1.6 = 0.80 lbs. of water vapor
Products of combustion = 13.76 lbs. hr. per lb. of waste	Products of combustion = 10.80 lbs. hr. per lb. of waste	Products of combustion = 7.68 lbs. hr. per lb. of waste
or $\frac{13.76 \text{ lbs.} \times 46.86}{3600}$ = 0.179 cu. ft. sec. @ 1400° F.	or $\frac{10.80 \text{ lbs.} \times 46.86}{3600}$ = 0.140 cu. ft. sec. @ 1400° F.	or $\frac{7.68 \text{ lbs.} \times 46.86}{3600}$ = 0.099 cu. ft. sec. @ 1400° F.

Type 3 waste	Type 4 waste	Minimum incinerator volume Given in cu. ft. lb. of rated capacity per hr.
$\frac{1 \times 15 \times 2500}{10{,}000}$ = 3.750 lbs. of air	$\frac{1 \times 15 \times 1000}{10{,}000}$ = 1.50 lbs. of air	Type 0 waste = $\frac{8500}{25{,}000}$ = 0.34 cu. ft
1 × .25 = 0.250 lbs. of combustibles	1 × .10 = .10 lbs. of combustibles	Type 1 waste = $\frac{6500}{25{,}000}$ = 0.26 cu. ft.
1 × .70 × 1.6 = 1.120 lbs. of water vapor	1 × .85 × 1.6 = 1.36 lbs. of water vapor	
$\frac{1500 \times 10}{1050 \times 13.35}$ = 1.071 lbs. of air for aux. fuel	$\frac{3000 \times 10}{1050 \times 13.35}$ = 2.15 lbs. of air for aux. fuel	Type 2 waste = $\frac{4300}{25{,}000}$ = 0.172 cu. ft.
$\frac{1500 \times .044}{1050}$ = 0.062 lbs. of aux. fuel	$\frac{3000 \times .044}{1050}$ = 0.125 lbs. of aux. fuel	Type 3 waste = $\frac{2500 + 1500}{25{,}000}$ = 0.15 cu. ft.
Products of combustion = 6.253 lbs. hr. per lb. of waste	Products of combustion = 5.325 lbs. hr. per lb. of waste	
or $\frac{6.253 \text{ lbs.} \times 46.86}{3600}$ = 0.082 cu. ft. sec. @ 1400° F.	or $\frac{5.325 \text{ lbs.} \times 46.86}{3600}$ = 0.069 cu. ft. sec. @ 1400° F.	Type 4 waste = $\frac{1000 + 3000}{25{,}000}$ = 0.15 cu. ft.

Note. The specific gravity of dry air or dry gas is 1.0, and the specific gravity of water vapor is 0.6215. In the above calculations, 1.6 is used as a multiplier to correct for the difference in specific gravity between dry air-gas and water vapor. This produces an equivalent weight for water vapor before adding to the other products of combustion. The 1.6 can only be used if it is the intent to convert the total weight of the products of combustion to volume at a given temperature.

M-902.4.2 Auxiliary firing: All auxiliary firing equipment for incinerators and crematories shall comply with Article 6.

M-902.5 Permits

M-902.5.1 Permit to construct: A permit shall be required to erect an incinerator.

M-902.5.2 Permit to operate: A permit to operate any incinerator, except gas-fired domestic, shall be required. The permit shall be issued only after a satisfactory performance test has been conducted as required in Section M-902.9.2.

M-902.6 Waste analysis: The basis for satisfactory incinerator operation is the proper analysis of the waste to be destroyed, and the selection of proper equipment to best destroy that particular waste. For purposes of this article, all types of waste to be destroyed shall be classified as indicated in the following Sections M-902.6.1 through M-902.6.8 (see also Table M-902.6).

M-902.6.1 Type 00 waste: Trash, consisting of a mixture of highly combustible waste such as paper, paper products, cardboard, cartons, wood boxes and combustible floor sweepings from commercial and industrial activities. The mixture contains up to ten (10) per cent by weight of plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags and plastic or rubber scrap. This type of waste contains up to ten (10) per cent moisture, five (5) per cent noncombustible solids, has a bulk density of less than eight (8) pounds per

Table M-902.6.1

MAXIMUM BURNING RATE LBS./SQ. FT./HR. OF VARIOUS TYPES WASTES

Capacity lbs/hr	Logarithm	Types 00, 0, 1 and 2 waste factor 10	Type 3 waste factor 8	Type 4 waste no factor
100	2.0	20	16	10
200	2.30	23	18	12 *
300	2.48	25	20	14 *
400	2.60	26	21	15 *
500	2.70	27	22	16 *
600	2.78	28	22	17 *
700	2.85	28	23	18 *
800	2.90	29	23	18 *
900	2.95	30	24	18 *
1000	3.00	30	24	18 *

*The maximum burning rate in lbs./sq. ft./hr. for Type 4 waste depends to a great extent on the size of the largest animal to be incinerated. Therefore whenever the largest animal to be Incinerated exceeds one-third (⅓) the hourly capacity of the incinerator, use a rating of ten lbs./sq. ft./hr. for the design of the incinerator.

Table M-902.6
CLASSIFICATION OF WASTES TO BE INCINERATED

Type of waste		Principal components	Approximate composition % by weight and density	Moisture content %	Noncombustible solids %	Btu value/ lb. of refuse as fired	Btu of aux. fuel per lb. of waste to be included in combustion calculations	Min./Btu/hr. burner input per lb. waste primary chamber unless otherwise specified
Type	Description							
00 and 0[a]	Trash	Combustible waste, paper, paper products, cartons, rags, wood scraps, floor sweepings, domestic, commercial, industrial sources. The mixture contains up to 10% plastic bags, coated or treated paper products, and rubber or plastic scrap.[b]	Waste containing less than 10% plastic or rubber scrap. Density of 00 trash less than 8 lbs/cu. ft. and 0 trash 8 to 10 lbs/cu. ft.	10	5	8500	0	0 (See Section M-902.3.5)
1[a]	Rubbish	Combustible waste, paper, paper products, cartons, rags, wood scraps, floor sweepings, domestic, commercial, industrial sources	Rubbish 100% Garbage up to 20% Density 8-10 lbs/ft.^{3}	25	10	6500	0	0 (See Section M-902.3.5)
2[a]	Refuse	Rubbish and garbage; residential sources	Rubbish 50% Garbage 50% Density 15-20 lbs/ft^3	50	7	4300	0	1500 (See Section M-902.3.5)

Table M-902.6 (cont'd.)
CLASSIFICATION OF WASTES TO BE INCINERATED

Type of waste		Principal components	Approximate composition % by weight and density	Moisture content %	Noncombustible solids %	Btu value/ lb. of refuse as fired	Btu of aux. fuel per lb. of waste to be included in combustion calculations	Min./Btu/hr. burner input per lb. waste primary chamber unless otherwise specified
Type	Description							
3[a]	Garbage	Animal and vegetable wastes, restaurants, hotels, markets, institutional, commercial, and club sources	Garbage 100% Rubbish up to 35% Density 30-35 lbs/ft^3	70	5	2500	1500	3000
4	Animal solids and organic wastes	Carcasses, organs, solid organic wastes; hospital, laboratory, abattoirs, animal pounds, and similar sources	100% animal and human tissue Density 45-55 lbs/ft^3	85	5	1000	3000	5000 Primary 3000 Secondary
5	Gaseous liquid or semi-liquid wastes	Industrial process wastes	Variable	Dependent on predominant components	Variable according to wastes survey	Variable according to wastes survey	Variable according to wastes survey	Variable according to wastes survey
6	Semi-solid and solid wastes	Combustibles requiring hearth, retort, or grate burning equipment	Variable	Dependent on predominant components	Variable according to wastes survey	Variable according to wastes survey	Variable according to wastes survey	Variable according to wastes survey

Note a. The above figures on moisture content, ash, and Btu as fired have been determined by analysis of many samples for use in computing heat release, burning rate, velocity, and other details of incinerator designs. Any design based on these calculations can accommodate minor variations.

Note b. When trash composition is such that any single charge to the incinerator will contain over ten (10) percent plastic or rubber scrap by weight, the waste shall be classed Type 6.

cubic foot and has a heating value of eighty-five hundred (8500) Btus per pound as fired.

M-902.6.2 Type 0 waste: Trash, consisting of a mixture of highly combustible waste such as paper, paper products, cardboard, cartons, wood boxes and combustible floor sweepings from commercial and industrial activities. The mixtures contain up to ten (10) per cent by weight of plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags and plastic or rubber scrap. This type of waste contains up to ten (10) per cent moisture, five (5) per cent noncombustible solids, has a bulk density of eight (8) to ten (10) pounds per cubic foot and has a heating value of eighty-five hundred (8500) Btus per pound as fired.

M-902.6.3 Type 1 waste: Rubbish, consisting of combustible waste such as paper, paper products, cartons, rags, wood scraps, sawdust, foilage and floor sweepings from domestic, commercial and industrial activities. This type of waste contains up to twenty-five (25) per cent moisture up to ten (10) per cent noncombustible solids, has a bulk density of eight (8) to ten (10) pounds per cubic foot and has a heating value of sixty-five hundred (6500) Btus per pound as fired.

M-902.6.4 Type 2 waste: Refuse consisting of an approximately even mixture of rubbish and garbage by weight. This type of waste consists of up to fifty (50) per cent moisture, seven (7) per cent noncombustible solids, has a bulk density of fifteen (15) to twenty (20) pounds per cubic foot and has a heating value of forty-three hundred (4300) Btus per pound as fired.

M-902.6.5 Type 3 waste: Garbage consisting of animal and vegetable wastes. This type of waste contains up to seventy (70) per cent moisture, up to five (5) per cent in combustible solids, has a bulk density of thirty (30) to thirty-five (35) pounds per cubic foot and has a heating value of twenty-five hundred (2500) Btus per pound as fired.

M-902.6.6 Type 4 waste: Human parts and animal remains consisting of carcasses, organs and solid organic wastes. This type of waste contains up to eighty-five (85) per cent moisture, five (5) per cent noncombustible solids, has a bulk density of forty-five (45) to fifty-five (55) pounds per cubic foot and has a heating value of one thousand (1,000) Btus per pound as fired.

M-902.6.7 Type 5 waste: By-product waste, gaseous, liquid or semi-liquid, such as tar, paints, solvents, sludge, fumes, etc. Btu values shall be determined for the individual materials to be incinerated.

M-902.6.8 Type 6 waste: Solid by-product waste, such as rubber, plastics, woodwaste, etc. Btu values shall be determined for the individual materials to be incinerated.

M-902.7 Classification of incinerators

M-902.7.1 Class I: Portable, packaged or job assembled direct-fed incinerators of five (5) cubic feet storage capacity, or twenty-five (25) pounds per hour burning rate, for Type 1 or Type 2 waste.

M-902.7.2 Class 1A: Portable, packaged or job assembled direct-fed incinerators of five (5) cubic feet to fifteen (15) cubic feet primary chamber volume of twenty-five (25) pounds per hour up to, but not including, one hundred (100) pounds per hour burning rate, for Type 1 or Type 2 waste.

M-902.7.3 Class IIA: Flue-fed incinerators shall be served by two (2) flues, one (1) for charging waste and one (1) for carrying the products of combustion.

M-902.7.4 Class III: Direct-fed incinerators with a burning rate of one hundred (100) pounds per hour and over, for Type 00, Type 0, Type 1 or Type 2 waste.

M-902.7.5 Class IV: Direct-fed incinerators with a burning rate of seventy-five (75) pounds per hour or over, for Type 3 waste.

M-902.7.6 Class V: Municipal incinerators.

M-902.7.7 Class VI: Crematory and pathological incinerators, for Type 4 waste.

M-902.7.8 Class VII: Incinerators designed for specific by-product wastes, for Type 5 or Type 6.

M-902.8 Requirements for incinerators by "class-of-incinerator"

M-902.8.1 General: These requirements are in addition to the requirements of Section M-902.7.

M-902.8.2 Class I: This class of incinerators is for Type 1 or Type 2 waste.

M-902.8.2.1 Such incinerators shall have a sufficient thickness of refractory lining and insulation to prevent the shell temperature from exceeding one hundred (100) degrees F. above normal room temperature but shall not exceed one hundred eighty (180) degrees F. Provisions shall be made for expansion to reduce or eliminate injury to the incinerator.

M-902.8.2.2 Such incinerators shall be constructed to withstand intermittent internal temperatures of eighteen hundred (1800) degrees F. without failure of structural parts, such as cracking or warping, and so as to permit flame passage or emission of combustion gases or sparks to the exterior.

M-902.8.3 Class IA: This class of incinerators is for Type 1 or Type 2 waste.

M-902.8.3.1 The design shall be such that when the incinerator is fired with normal waste to be burned at its rated capacity (in pounds per hour of Type 1 waste or Type 2 waste), the shell temperature at any point shall not exceed one hundred eighty (180) degrees F. The only exception to this maximum temperature shall be at the surface of the doors and frame and/or at the breeching outlet. The minimum acceptable construction of the incinerator shall be No. 16 Manufacturers' Standard Gage (0.060 inch) steel exterior casing one (1) inch in thickness of high temperature block insulation and a two and one-half (2½) inch thickness of high heat duty firebrick or a two and one-half (2½) inch thickness of castable or plastic refractory. The castable or plastic refractory shall be properly anchored to the exterior steel casing.

M-902.8.3.2 Such incinerators shall be constructed to withstand intermittent internal temperatures of eighteen hundred eighty (1880) degrees F. without cracking, warping, or other failure of structural parts so as to permit flame passage or emission of combustion gases or sparks to the exterior.

M-902.8.4 Class IIA: This class of incinerator is for Type 1 or Type 2 waste fed in small compact packages from two (2) or more floors above the incinerator. This class of incinerator shall be provided with automatic sequence of operation.

M-902.8.4.1 Class IIA incinerators shall be served by two (2) flues, one (1) for charging waste and one (1) for carrying the products of combustion. A positive method shall be employed to prevent smoke and fumes from escaping into the charging flue, and provisions shall be made to ensure that the charging flue remains free of vermin and odor.

M-902.8.4.2 The minimum burning area shall be ten one-hundredths (0.10) square foot per sleeping room and combustion calculations shall be based on three (3) hours burning per day. Burning area may consist of a combination drying hearth and cast iron grate, but the hearth area shall not exceed fifty (50) per cent of the total burning area.

M-902.8.4.3 The primary chamber shall have a volume of at least four (4) cubic feet for each square foot of burning area. The shell temperature shall not exceed ninety (90) degrees F. above normal room temperature but shall not exceed one hundred eighty (180) degrees F.

M-902.8.4.4 Primary (underfire), secondary and overfire air shall be provided through adjustable openings to meet the minimum requirements as set forth in Section M-902.2.14.

M-902.8.4.5 Service openings at each floor shall not have a daylight opening that exceeds one-third (⅓) the cross-sectional area of the charging flue. The daylight opening shall not exceed one hundred sixty (160) square inches. Such service opening or other charging device shall be designed without projection into the flue and with the opening to the flue interior closed off while the service opening door is fully open. This door shall close auomatically upon release. Service openings shall be located in an area of the building where ventilating or air conditioning will not create negative pressures; i.e., use the flue as a source of air when the service opening is open.

M-902.8.4.6 Refractory lining of the incinerators shall meet the requirements of Section M-902.2.5.

M-902.8.4.7 Incinerators under this class shall contain a system to control gas velocities and emissions. This system shall include secondary combustion chambers, burners, settling chambers and gas washers or scrubbers.

M-902.8.5 Class III: This class of incinerator is for Type 1 or Type 2 waste.

M-902.8.5.1 When designed to burn Type 1 waste, the incinerator shall contain cast iron grates, stationary or dump, or combination thereof with air openings of at least forty (40) per cent of total burning area. In lieu of one hundred (100) per cent grate area, up to twenty (20) per cent of the total burning area may be solid hearth.

M-902.8.5.2 When designed to burn Type 2 waste, the incinerator shall contain combination drying hearth and cast iron grate area, each approximately fifty (50) per cent of the total burning area. Where step grates or sloping grates are used in lieu of hearth, they shall provide at least fifty (50) per cent of the grate surface.

M-902.8.5.3 Maximum burning rate per square foot of primary area shall be as indicated in Table M-902.6.1. The areas of grate and hearth shall be calculated on a horizontal projected area and not on the line of the slope or area of individual steps.

M-902.8.6 Class IV: This class of incinerator is for burning Type 3 waste on a hot drying hearth.

M-902.8.6.1 Maximum burning rate per square foot of primary area shall be as indicated in Table M-902.6.1. The area of the hearth shall be calculated on a horizontal projected area and not on the line of the slope of area of individual steps.

M-902.8.6.2 Gas fuel burners shall be provided as required in Table M-902.6. Burners shall comply with the provisions of Section M-902.4.

M-902.8.7 Class V: Construction of this class of equipment shall be subject to special design formulae.

M-902.8.7.1 The incinerator shall provide for automatic feeding and firing. Prior to installation, plans and design criteria shall be submitted to the department for review and approval.

M-902.8.8 Class VI: This class of incinerator is for Type 4 waste.

M-902.8.8.1 The incinerator shall be designed to burn the refuse on a hot refractory hearth. The maximum burning rate per square foot of hearth shall be as indicated in Table M-902.6.1.

M-902.8.8.2 The incinerator shall have burners in both the primary and the secondary chambers, and the Btu inputs shall be as required in Table M-902.6. Burners shall comply with the requirements of Section M-902.4.

M-902.8.8.3 The curtain wall shall be designed to direct the hot gases beneath the hearth.

M-902.8.8.4 The volume of the primary chamber shall not be more than sixty (60) per cent of the total incinerator volume.

M-902.8.9 Class VII: This class of incinerator shall be the same as Class III, Class IV and Class VI.

> **Exception:** Heat release, burning rate and velocities shall be determined from an analysis of waste to be incinerated in each instance.

M-902.9 Incinerator by engineered design

M-902.9.1 General: An incinerator deviating from this article as to design and/or construction shall be considered an equal if tests, as outlined in Section M-902.9.2, show emission standards are met. Design criteria and drawings shall be submitted to the department for approval.

M-902.9.2 Test procedures: The ASME Performance Test Code 27 (see Appendix C) procedure shall serve as a basis for smoke and fly ash emission tests. All tests shall be conducted at rated capacity or less for a continuous duration of three (3) hours or less, as may be approved by the department. Tests shall be conducted with waste typical of that to be generated by the user.

M-902.10 Incinerator construction

M-902.10.1 General: Minimum construction requirements shall be as set forth in this article. High temperature block insulation shall be required for its high insulating qualities and resistance to deformation under high temperature. High heat duty refractory shall be required for its resistive qualities to temperature, spalling, abrasion and disintegration. It is not the intent of this article to preclude the use of specialty refractory materials for construction, even though such special refractory does not have all the resistive qualities of the refractories outlined herein. Refractory materials as approved by the department may be used in certain areas where the special characteristics are of particular advantage, provided the materials have all of the resistive qualities required for that area. For example, where weight of the structure is an important factor, insulating firebrick or insulating castable may be used but shall not be used in any area where they are subject to abrasion from tools, materials or high velocity gases.

M-902.10.2 High temperature block: The high temperature block insulation required by this article shall meet Commercial Standards CA 117 and ASTM C612, Class 2 listed in Appendix C.

M-902.10.3 Refractory brick: The high heat duty refractory brick required by this article shall be in accordance with ASTM C64 listed in Appendix C.

M-902.10.4 Hydraulic setting castable refractory: The hydraulic setting castable refractory required by this article shall be in accordance with ASTM C64, Class C listed in Appendix C.

M-902.10.4.1 All castable refractory walls shall be installed to form a monolithic structure and shall be anchored to the exterior shell of the incinerator. The arches of the suspended type shall be constructed so that their weight does not rest on refractory walls. Alloy steel or refractory anchors shall be spaced not more than eighteen (18) inches horizontally and vertically and in accordance with the refractory manufacturer's instructions.

SECTION M-903.0 REFUSE AND TRASH CHUTES

M-903.1 General: Refuse chutes shall not feed directly to the combustion chamber of an incinerator unless otherwise permitted by this article. Such chutes shall discharge into a room or bin enclosed and separated from the incinerator room by floors, ceilings and walls of at least two (2) hour fireresistance rated construction. The opening through which material is transferred from such room or bin to the incinerator shall be equipped with a one and one-half (1½) hour fireresistance rated door with an approved self-closing device. Refuse chutes shall rest on a noncombustible foundation.

M-903.2 Construction: The enclosing walls of such chutes shall consist of clay or shale brickwork at least eight (8) inches thick, or of reinforced concrete at least six (6) inches thick or other approved material. Such chutes shall be lined with low duty refractory brick (ASTM C64), or the equivalent, not less than four and one-half (4½) inches thick.

M-903.3 Termination (height): Chutes shall extend to at least four (4) feet above the roof and shall be covered by a metal skylight glazed with approved plain glass or as approved by the department.

SECTION M-904.0 CREMATORIES

M-904.1 General: In addition to the other requirements of this code, the following shall govern the construction of crematories. For purposes of this code, a crematory shall include any device used to incinerate human bodies, for which burial permits are required by either the State of *[name of state]* or the *[name of jurisdiction]*. Pathological incinerators shall be treated as commercial incinerators.

M-904.2 Construction

M-904.2.1 Firebox: The firebox of every crematory shall be enclosed with walls and ceilings with at least (6) inches of super duty refractory brick set in super duty refractory mortar (ASTM C64), backed with two and one-half (2½) inches of insulating firebrick (ASTM C-155 Group 20) or the equivalent. The outside covering for such firebox shall be constructed of at least No. 12 U.S. Standard Gage (0.105 inch) steel.

M-904.2.2 Alternative fireboxes: Other approved firebox construction may be used in lieu of the requirements of this section, provided the exterior shell temperature does not exceed one hundred sixty (160) degrees F.

M-904.2.3 Combustion chamber: The lining of a crematory combustion chamber shall be super duty refractory brick, pyrometric cone equivalent to at least a cone No. 33 (ASTM C64). The lining of secondary combustion chambers, connecting passageways and breechings, shall be at least high duty refractory brick, pyrometric cone equivalent to a cone No. 31.5 (ASTM C64). Super or high duty refractory bricks, when used, shall be laid in high temperature mortar (ASTM C105).

M-904.2.4 Castable refractory: Castable refractory products may be approved in lieu of super, high or medium duty refractory brick, respectively, provided such is equivalent to super, high or medium duty fireclay refractory brick in accordance with Class F, C or B castable refractory (ASTM C64).

M-904.2.5 Chimneys: The lining of chimneys shall be at least medium duty refractory brick, pyrometric cone No. 29 (ASTM C64) or equivalent.

M-904.3 Prefabricated crematories: Prefabricated-type crematories shall be approved by the department when conforming to the requirements of this article or as an alternate material or method as described in the building code.

M-904.4 Burners

M-904.4.1 Connections and installations: In addition to the requirements of this article, installation of gas or liquid fuel burners, venting, piping and controls in connection with crematories shall comply with Articles 5, 6 and 7.

M-904.4.2 Air: Burners for crematories shall be power burners with primary and secondary air supplied by a blower. Combustion air shall be supplied from outside the building. Air intake shall be designed so that velocity at the louver shall not exceed three hundred (300) feet per minute based on twenty (20) per cent excess air.

M-904.4.3 Pilots: Burners shall be provided with a gas or liquefied petroleum gas pilot controlled by a flame rod or ultraviolet scanner or approved electronic controls.

M-904.4.4 Flame failure: Burners shall be provided with one hundred (100) per cent flame failure protection with manual reset or as approved by the department.

M-904.4.5 Oil: Oil burners shall use oil not heavier than No. 2 fuel oil.

M-904.4.6 Limiting controls: Crematory burners shall be provided with indicating high temperature limiting controls with thermocouples mounted in both primary and secondary chambers.

M-904.4.7 Primary and secondary chambers: Burners shall be provided in both the primary and secondary chambers.

M-904.4.8 Heat release: Total heat release within the combustion chamber shall not exceed forty thousand (40,000) Btus per cubic foot per hour.

M-904.4.9 Barometric damper: A barometric damper shall be provided to control the draft of the crematory in accordance with manufacturer's recommendations.

M-904.4.10 Induced draft: Where an induced draft fan is used, a low draft switch shall be provided and interlocked with all burners.

M-904.5 Electrical: Any electrical work performed in connection with the installation of a crematory shall be accomplished in accordance with the electrical code of this jurisdiction.

M-904.6 Location

M-904.6.1 Requirements: Crematories shall be installed in a room which shall comply with the following:

1. walls, floor and ceiling shall be constructed of at least one (1) hour fireresistance rated material or equivalent to the fireresistance rating of the building itself, whichever is more restrictive;
2. fireresistance rated doors shall be installed equivalent to the type of enclosure required; and
3. openings into a garage or areas where flammable liquids are used or stored shall not be permitted.

M-904.6.2 Prefabricated crematories: The location and use of prefabricated or other types of crematories shall require approval from the department prior to installation.

M-904.7 Name plate: Every crematory shall be provided with a metal plate or plates permanently attached to the crematory in a conspicuous location so that it may be easily read. The plate shall bear the manufacturer's name, the trade name of the crematory, if any, the model number, the rated capacity for which it is designed and date installed.

M-904.8 Operating instructions: Complete instructions for the proper operation of the crematory and all necessary equipment shall be posted on a card adjacent to the crematory and shall include at least the following: (1) steps required to start and stop burners; (2) operation of controls and instruments, and (3) routine maintenance required.

M-904.9 Ventilation: See Article 3.

SECTION M-905.0 FIREPLACES

M-905.1 General: Fireplaces, barbecues, smoke chambers and fireplace chimneys shall be of solid masonry or reinforced concrete or other approved materials and shall conform to requirements of this section.

M-905.2 Construction: Structural walls of fireplaces shall be at least eight (8) inches thick. Where a lining of low duty refractory brick (ASTM C64), or the equivalent, at least two (2) inches thick laid in fire clay mortar (ASTM C105, medium duty), or the equivalent, or other approved lining is provided, the total thickness of back and sides, including the lining, shall be not less than eight (8) inches. Where such lining is not provided, the thickness of back and sides shall be not less than twelve (12) inches. The firebox shall be twenty (20) inches in depth and will be permitted to be open on all sides provided all fireplace openings are located entirely within one (1) room.

M-905.3 Lining: The lining shall extend from the throat of the fireplace to a point at least four (4) inches above the top of the enclosing masonry walls.

M-905.4 Clearance

M-905.4.1 The distance between fireplace and combustibles shall be at least four (4) inches, and such combustible shall not be placed within six (6) inches of the fireplace opening. Wood facings or trim normally placed around the fireplace opening may be permitted when conforming to the requirements of this section; however, such facing or trim shall be furred out from the fireplace wall at least four (4) inches and attached to noncombustible furring strips. The edges of such facings or trim shall be covered with a noncombustible material. Where the walls of the fireplace are twelve (12) inches thick, the facings or trim may be directly attached to the fireplace.

M-905.4.2 Metal hoods used as part of a fireplace or barbecue shall be at least eighteen (18) inches from combustible material unless approved for reduced clearances.

M-905.5 Metal: Metal hoods used as a part of a fireplace or barbecue shall be at least No. 18 B & S Sheet Gage copper (0.40 inch), No. 18 Galvanized Sheet Gage (0.052 inch) galvanized steel or other equivalent corrosion-resistant ferrous metal with all seams and connections of smokeproof unsoldered construction. The hoods shall be sloped at an angle of forty-five (45) degrees F. or less from the vertical and shall extend horizontally at least six (6) inches beyond the limits of the firebox.

M-905.6 Metal heat circulators: Approved metal heat circulators may be installed in fireplaces, provided the thickness of the fireplace walls are not reduced.

M-905.7 Smoke chamber: All walls including back walls shall be at least eight (8) inches in thickness.

M-905.8 Areas of flues, throats, and dampers: The net cross-sectional area of the flue and of the throat between the firebox and the smoke chamber of a fireplace shall be at least that required by Section M-702.0. When dampers are used, damper openings shall be at least, when fully opened, equal to the required flue area and shall be of not less than No. 12 Manufacturers' Standard Gage (0.105 inch) metal.

M-905.9 Lintel: Masonry over the fireplace opening shall be supported by a noncombustible lintel.

M-905.10 Hearth: Every fireplace shall be constructed with a hearth of brick, stone, tile or other noncombustible material. For fireplaces with an opening of less than six (6) square feet, the hearth shall extend not less than sixteen (16) inches in front and not less than eight (8) inches on each side of the fireplace opening. For fireplaces with an opening of six (6) square feet or more, the hearth shall extend not less than twenty (20) inches in front and not less than twelve (12) inches on each side of the fireplace opening. Such hearths shall be supported on trimmer arches of brick, stone, tile or concrete not less than four (4) inches thick or other equally strong and fireresistive materials. All combustible forms or centering shall be removed after completion of the supporting construction.

M-905.11 Firestopping: Firestopping between chimneys and wooden construction shall meet the requirements specified in the building code.

M-905.12 Support: Fireplaces shall be supported on foundations designed in conformity with the building code or as approved by the department.

M-905.13 Screens: Screens or another acceptable protection device shall be provided for all fireplace openings.

M-905.14 Other type fireplaces: Other fireplaces not conforming to the requirements of this section shall be subject to approval by the department prior to installation. Imitation fireplaces shall not be used for the burning of gas, solid or liquid fuel. Approved factory-built fireplaces may be installed and shall conform to the applicable portions of this code. Factory-built fireplaces shall bear the seal of a nationally recognized testing or inspection agency.

M-905.15 Solid wastes: Solid waste shall not be burned in a fireplace or barbecue.

SECTION M-906.0 FIXED BARBECUE PITS

M-906.1 General: Commercial type barbecue pits shall conform to the requirements of Section M-905.0.

ARTICLE 10

FIRE SUPPRESSION SYSTEMS

SECTION M-1000.0 GENERAL

M-1000.1 Scope: The provisions of this article shall govern the installation, repair, operation and maintenance of fire suppression systems in all occupancies except one- and two-family dwellings.

M-1000.2 Installation requirements: The installation methods, repair, operation or maintenance of fire protection systems shall be in accordance with this code and the building code listed in Appendix B.

M-1000.3 Maintenance: The owner, tenant or lessee of every building or structure shall be responsible for the care and maintenance of all fire protection systems, including equipment and devices, to insure the safety and welfare of the occupants. Fire protection systems shall not be disconnected or otherwise rendered unserviceable without first notifying the fire department. When installations of required fire protection systems are interrupted for repairs or other necessary reasons, the owner, tenant or lessee shall immediately advise the fire department and shall diligently prosecute the restoration of the protection.

M-1000.4 Threads: All threads provided for fire department connections, to sprinkler systems, standpipe systems, yard hydrants or any other fire hose connections shall be uniform to those used by the local fire department.

M-1000.5 Signs: If fire suppression control valves are located in a separate room, or building, a sign shall be provided on the entrance door. The lettering for such sign shall be of a conspicuous color and shall be at least four (4) inches in height and shall read *Sprinkler control valves* and/or *Standpipe control valves* or indicate other types of systems (see Section M-1014.8 for additional signs).

M-1000.6 Material and equipment: All materials and equipment used in a fire suppression system shall be approved, consistent with the requirements of this code (Section M-120.0) and the standards as listed in Appendices B and C.

M-1000.7 Automatic fire alarm system: See the building code of this jurisdiction.

M-1000.8 Manual fire alarm system: See the building code of this jurisdiction.

M-1000.9 Tests: Where required by this article and the standards referenced herein, all flow test connections and points of fluid discharge shall be reasonably accessible and acceptable to the administrative authority.

SECTION M-1001.0 DEFINITIONS

Automatic detecting device: A device which automatically detects heat, smoke or other products of combustion.

Automatic fire alarm system: A manual fire alarm system containing automatic detecting device(s) which actuates a fire alarm signal.

Automatic sprinkler(s): A device, connected to a water supply system, that opens automatically at a predetermined fixed temperature and disburses a spray of water.

Automatic sprinkler system: A sprinkler system, for fire protection purposes, is an integrated system of underground and/or overhead piping designed in accordance with fire protection engineering standards. The system includes a suitable water supply. The portion of the system above ground is a network of specially sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which automatic sprinklers are connected in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the fire area.

Automatic water supply: Water supplied through a gravity or pressure tank or automatically operated fire pumps, or from a direct connection to an approved municipal water main.

Carbon dioxide extinguishing system (CO_2): A system to supply CO_2 from a pressurized vessel through fixed pipes and nozzles. The system includes an automatic detection and actuating mechanism.

Central station system: A system, or group of systems, the operations of which are signaled to, recorded in, maintained and supervised from an approved central station, in which there are competent and experienced observers and operators in attendance at all times whose duty it shall be, upon receipt of a signal, to take such action as shall be required under the rules established for their guidance. Such systems shall be controlled and operated by a person, firm, or cooperation whose principal business is the furnishing and maintaining of supervised protective signaling service and who does not have interest in the protected properties.

Deluge system: An automatic sprinkler system consisting of open sprinklers with water supply valves activated by a separate automatic detection system.

Dry chemical extinguishing system: A system consisting of dry chemical and expellant gas storage tanks, fixed piping, and nozzles used to assure proper distribution of an approved extinguishing agent on a specific fire hazard or into a potential fire area. The system includes an automatic detection and actuating mechanism.

Fire department connection: A connection for the fire department use in supplementing or supplying water for standpipes or sprinkler systems.

Fire protection system: A system including systems, devices, and equipment to detect a fire, actuate an alarm, suppress or control a fire, or any combination thereof.

Fire suppression system: A mechanical system designed and equipped to detect a fire, actuate an alarm and suppress or control a fire.

Foam extinguishing system: A special system to discharge a foam made from concentrates, either mechanically or chemically, over the area to be protected.

Halogenated extinguishing system: A system of pipes, nozzles, an actuating mechanism and a container of halogenated agent under pressure.

Limited area sprinkler system: An automatic sprinkler system consisting of not more than twenty (20) sprinklers for use in a room or space enclosed by construction assemblies as required by the building code.

Manual fire alarm system: An interior alarm system composed of sending stations and signaling devices in a building, operated on an electric circuit, and so arranged that the operation of any one (1) station will ring all signals throughout the building and at one (1) or more approved locations.

Occupancy sprinkler system: An automatic sprinkler system servicing a use group in a building enclosed by construction assemblies as required by the building code.

Proprietary (local) system: An electrical alarm system capable of automatically notifying building supervisory personnel of a water flow and/or an impairment of a sprinkler system.

Remote station system: An electrical alarm system capable of automatically notifying public or private fire departments, or other approved constantly attended locations, when the system is activated.

Riser: The vertical supply pipes in a sprinkler system or standpipe system.

Sprinkler alarm system: An alarm activated by waterflow from a sprinkler system.

Standpipe: A wet or dry fire pipe line, extending from the lowest to the topmost story of a building or structure, equipped with a shut-off valve with hose outlets at every story.

Water spray fixed system: A system using water in a form having a predetermined pattern, particle size, velocity, and density discharged from specially designed nozzles or devices.

SECTION M-1002.0 PLANS AND SPECIFICATIONS

M-1002.1 Required: Plans shall be submitted to indicate conformance with this code and the building code of this jurisdiction, and shall be reviewed by the department prior to issuance of the permit.

Note: Since the fire department is responsible for inspection for the proper maintenance of fire protection systems in buildings, the administrative authority shall cooperate with the fire department in the discharging of his responsibiliy to enforce this article.

M-1002.2 Plans: The plans and specifications submitted to the department shall contain sufficient detail to evaluate the hazard and to evaluate the effectiveness of the system. The details on the hazards shall include materials involved, the location and arrangement, and the exposure to the hazard.

M-1002.3 Calculations: The details on the fire protection system shall include the design considerations, calculations and other information as required by this code and the building code of this jurisdiction.

SECTION M-1003.0 FIRE SUPPRESSION SYSTEMS

M-1003.1 Where required: Fire suppression systems shall be installed and maintained in full operating condition, as specified in this code, in the following locations, except one- and two-family dwellings, indicated in Sections M-1003.2 through M-1003.21.

M-1003.2 Assembly (A-1) use: In all buildings or portions thereof of A-1 (assembly, theatres) use group.

Exception: Auditoriums, foyers, lobbies and toilet rooms.

M-1003.3 Assembly (A-2) use: In all buildings or structures or portions thereof of use group A-2 (assembly, night clubs):

1. when more than five thousand (5,000) square feet in area; or
2. when more than one (1) story in height.

M-1003.4 Assembly (A-3) use: In all buildings or structures or portions thereof of use group A-3 (assembly) when more than twelve thousand (12,000) square feet in area.

M-1003.5 Stages in assembly (A) use: Stages of any size, in assembly occupancies (A) in the following locations:

1. over the stage;
2. stage gridirons when side wall sprinklers with one hundred thirty-five (135) degrees F. rated heads with heat-baffle plates are in-

stalled around the entire perimeter of the stage at points not more than thirty (30) inches below the gridiron, nor more than six (6) inches below the baffle plate;
3. under all fly galleries;
4. over the proscenium opening on the stage side;
5. under the stage;
6. in all basements, cellars, work rooms, dressing rooms, store rooms and property rooms; and
7. in toilet, lounge and smoking rooms.

M-1003.6 Business (B) use: In all buildings or structures of use group B (business) when more than twelve (12) stories or one hundred fifty (150) feet in height.

M-1003.7 High hazard (H) use: In all buildings or structures or portions thereof of use group H (high hazard).

M-1003.8 Institutional (I-2) use: In all buildings or structures or portions thereof of use group I-2 (institutional, incapacitated).

Exceptions
1. Buildings used for prosecuting public or civic services and activities of emergency character such as firehouses and police stations.
2. One (1) story hospitals with patient rooms having direct egress to grade level at the exterior of the building.
3. In hospitals of Type 1 construction, the automatic fire suppression system may be omitted from operating, X-ray rooms, delivery rooms, cardiac and intensive care rooms and patient sleeping rooms not exceeding six-hundred (600) square feet in area when each such room is protected by an automatic fire alarm system connected to a central annunciator panel.

M-1003.9 Mercantile (M), moderate hazard storage (S-1), or factory and industrial (F) uses: In all buildings or structures of use groups M, S-1, and F (mercantile, moderate hazard storage, or factory and industrial):

1. when more than twelve thousand (12,000) square feet in area; or
2. when more than twenty-four thousand (24,000) square feet in total area on all floors; or
3. when more than three (3) stories in height.

M-1003.10 Residential (R-1 and R-2) uses: In all buildings or structures of use groups R-1 (residential, hotels) and R-2 (residential, multifamily) when more than twelve (12) stories or one hundred fifty (150) feet in height.

M-1003.11 Public garages: In all public garages:

1. when more than ten thousand (10,000) square feet in area; or
2. when more than seven thousand five hundred (7,500) square feet in area and more than one (1) story in height; or

3. when more than five thousand (5,000) square feet in area, and more than two (2) stories in height; or
4. when more than three (3) stories in height; or
5. when located in buildings where the upper stories are designed for other uses; or
6. when located in any story that is more than fifty (50) per cent below grade.

   Exception: Open parking structures.

M-1003.12 **Bus garages:** In all bus garages:

1. when required by Section M-1003.11; or
2. when used as passenger terminals for four (4) or more buses; or
3. when used for storage or loading of four (4) or more buses.

M-1003.13 **Unlimited area buildings:** In "unlimited area buildings" of Type 2 (noncombustible) or Type 3 (exterior masonry wall) construction as required by the building code of this jurisdiction.

Exception: Special industrial uses as indicated in the building code of this jurisdiction.

M-1003.14 **Aircraft hangars:** In aircraft hangars.

M-1003.15 **Storage and workshop areas:** In all portions of use groups A (assembly), B (business), I (institutional) and R-1 and R-2 (residential, hotels and multi-family) occupied for storage, workshop or similar purposes.

Exception: Individual storage or work-shop areas located entirely within a dwelling unit.

M-1003.16 **Cellar or basement:** In every story, cellar or basement of all buildings where there is not provided at least twenty (20) square feet of opening entirely above the adjoining grade level in each fifty (50) lineal feet of exterior wall in the story, cellar or basement, on at least two (2) sides of the building. Openings shall have a minimum dimension of not less than twenty-two (22) inches. Such openings shall be unobstructed to allow fire fighting and rescue operations from the exterior.

Exception: If the area of a cellar exceeds two thousand, five hundred (2,500) square feet, an automatic fire suppression system is required.

For purposes of this section, an opening in an exterior wall qualifies as follows:

1. doors or access panels may be included in the determination of openings; and
2. windows may be included in the determination of openings if they provide a breakable glazed area of not less than twenty-two (22) inches in its least clear dimension.

M-1003.17 **Painting rooms:** In spray painting rooms or shops where painting, brushing, dipping, or mixing is regularly conducted using flammable materials.

M-1003.18 Trash rooms and chutes: In rooms or areas used for incineration, trash, laundry collection, or similar uses. At alternate floor levels and at the top of all chutes used in conjunction with these rooms or areas.

M-1003.19 Furnace rooms: In furnace rooms, boiler rooms and rooms for similar uses.

> **Exception:** Such rooms located entirely within and serving a single dwelling unit.

M-1003.20 Unenclosed vertical openings: In unenclosed vertical openings between floors where such openings are permitted by this code and the building code.

M-1003.21 Range hoods: In range hoods, in accordance with the following requirements listed below.

1. Where natural or liquefied petroleum gas is used as a fuel, a manual reset safety valve shall be installed on the gas service line to prevent fuel from flowing into the burner or pilot in the event of activation of any suppression (extinguishing) systems.
2. Hood and duct suppression (extinguishing) systems shall provide for both automatic and manual actuation of the system.
3. A manual station for activation of the suppression (extinguishing) system shall be located at or near one (1) of the means of egress from the area, but not nearer than ten (10) feet to the range hood, unless otherwise specifically approved.
4. The manual station shall be securely mounted not less than four and one-half (4½) feet nor more than five (5) feet above the floor.
5. The system shall be maintained at full operating capacity by the owner or tenant and shall be serviced every six (6) months. A metallic sign with contrasting letters and background shall indicate the manual station of the system and the proper operating (actuation) procedure.
6. All nozzles shall be accessible for cleaning and replacement.
7. CO_2 (carbon dioxide) suppression (extinguishing) systems shall be installed in accordance with the above and Section M-1009.6.
8. Dry chemical (approved dry chemical extinguishing media) suppression systems shall be installed in accordance with the above and Section M-1011.6.

M-1003.22 Alternate protection: In special use areas of buildings or structures, an automatic fire alarm system may be installed in lieu of a fire suppression system when approved by the building official and fire department and when such fire suppression system installation would be detrimental or dangerous to the specific use or occupancy.

M-1004.0 SUPPRESSION SYSTEM SELECTION

M-1004.1 General: To guide the administrative authority with the selection of the proper type of fixed fire suppression system, and the extinguishing agent for each type of hazard, fire may be classified as follows.

Class A	Fires involving ordinary combustible materials (such as wood, cloth, paper, rubber and many plastics) requiring the heat-absorbing (cooling) effects of water, water solutions, or the coating effects of certain dry chemicals which retard combustion.
Class B	Fires involving flammable or combustible liquids, flammable gases, greases and similar materials where extinguishment is most readily secured by excluding air (oxygen), inhibiting the release of combustible vapors, or interrupting the combustion chain reaction.
Class C	Fires involving energized electrical equipment where safety to the operator requires the use of electrically nonconductive extinguishing agents.

Note: Electrical fires should not be fought with portable Class A or B extinguishers, or with hand held solid stream nozzle. However, fixed water spray systems may be used to fight fires in energized electrical systems.

M-1004.2 Special hazards: In rooms or buildings containing combustibles, such as aluminum powder, calcium carbide, calcium phosphide, metallic sodium and potassium, quick-lime, magnesium powder, sodium peroxide, incompatible with the use of water as an extinguishing agent, other extinguishing agents shall be used.

M-1004.3 Types: Where a fire suppression system is required in this code, Table M-1004 may be used by the administrative authority to determine the type of suppression system suitable for the hazard involved, if not otherwise specified in this code.

M-1004.4 Installation: Fixed fire suppression systems shall be of an approved type designed and installed in accordance with the requirements of this code.

M-1004.5 Tests: All tests required by this code and the standards listed in Appendix B shall be conducted at the expense of the owner or his representative.

SECTION M-1005.0 WATER SPRINKLER SYSTEMS

M-1005.1 General: Water sprinkler extinguishing systems shall be of an approved type and installed in accordance with the provisions of this code and the standards listed in Appendix B (see Appendix D for general installation with basic components).

Table M-1004
GUIDE FOR SUPPRESSION SYSTEM SELECTION

Hazard	Water sprinklers or spray M-1005.0 to M-1007.0	Foam M-1008.0	Carbon dioxide or halogenated M-1009.0 and M-1010.0	Dry chemical M-1011.0
Class A fire potential	X	X	X	X
Class B fire potential	X	X	X	X
Class C fire potential	X		X	
Special fire hazard areas*				
Aircraft hangars	X	X	X	X
Alcohol storage	X	X	X	X
Ammunition loading	X			
Ammunition magazines	X			
Asphalt impregnating	X	X		
Battery rooms			X	
Carburetor overhaul shops	X	X	X	X
Cleaning plant equipment	X	X	X	X
Computer rooms	X		X	
Dowtherm	X			
Drying ovens	X		X	X
Engine test cells	X	X	X	
Escalators, stair wells	X			
Explosives: manufacturing, storage	X			
Flammable liquids storage	X	X	X	
Flammable solids storage	X			
Fuel oil storage	X	X		
Hangar decks	X	X		
Hydraulic oil, lubricating oil	X		X	
Hydro-turbine generators	X		X	
Jet engine test cells	X	X	X	
Library stacks	X		X	
Lignite storage and handling	X			
Liquefied petroleum gas storage	X			
Oil quenching bath	X	X	X	X
Paints: manufacturing, storage	X	X	X	X
Paint spray booths	X		X	X
Petrochemical storage	X	X	X	
Petroleum testing laboratories	X	X	X	
Printing presses	X		X	
Range hoods	X		X	X
Reactor and fractionating towers	X			
Record vaults			X	
Rubber mixing and heat treating	X			
Service stations (inside buildings)	X		X	
Shipboard storage	X		X	
Solvent cleaning tanks		X	X	X
Solvent thinned coatings		X	X	X
Switchgear rooms			X	
Transformers, circuit breakers (outdoors)	X			
Transformers, circuit breakers (indoors)	X		X	
Turbine lubricating oil	X	X	X	X
Vegetable oil, solvent extraction	X	X		

*Within buildings or areas, so classified, as to require a suppression system.

M-1005.2 Occupancy sprinkler system: Within a building of mixed occupancies and where an occupancy is required by this code to be sprinklered with more than twenty (20) sprinklers, the area shall be enclosed by construction assemblies as required by the building code and equipped with a complete sprinkler system.

M-1005.3 Design: The details on the system supplied with the plans and specifications shall include information and the calculations on the sprinkler spacing and arrangement with water supply and discharge requirements, size and equivalent lengths of pipe and fittings and water supply source. Sufficient information shall be included to identify the apparatus and devices used.

M-1005.4 Actuation: Water sprinkler extinguishing systems shall be automatically actuated unless otherwise specifically provided in this code.

M-1005.5 Sprinkler alarms: Approved audible or visual alarm devices shall be connected to every water sprinkler system and such alarm device shall be located in an approved location.

> **Exception:** Alarms and alarm attachments shall not be required for limited area sprinkler systems (see Section M-1006.5).

M-1005.5.1 Additional alarms: At least one (1) additional audible or visual alarm device shall be installed within the building.

M-1005.6 Water control valve tags: Identification tags shall be provided in accordance with the standards listed in Appendix B.

M-1005.7 Sprinkler riser: The sprinkler system riser(s) may also serve as the wet standpipe riser(s) in buildings required to have both systems or in buildings having both systems (see Section M-1012.4.1).

M-1005.8 Tests: A completed system shall be tested hydrostatically for two (2) hours without visible leakage at not less than two hundred (200) pounds per square inch (psi), or at fifty (50) psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi.

SECTION M-1006.0 LIMITED AREA SPRINKLER SYSTEMS

M-1006.1 General: A limited area sprinkler system shall be of an approved type and installed in accordance with the provisions of this code and the standards listed in Appendix B.

M-1006.2 Installation: Where the provisions of this code require a limited number of sprinklers, a limited area sprinkler system may be installed to comply with these requirements.

M-1006.3 Design: The detail on the system supplied with the plans and specifications shall include information and the calculations on the sprinkler spacing and arrangement with water supply and discharge requirements, size and equivalent lengths of pipe and fittings and water supply source. Sufficient information shall be included to identify the apparatus and devices used.

M-1006.4 Actuation: A limited area sprinkler extinguishing system shall be automatically activated.

M-1006.5 Sprinkler alarms: Alarms and alarm attachments shall not be required.

M-1006.6 Water supply: Limited area sprinklers may be supplied from the domestic water system provided the domestic water system is designed to adequately support the design flow of the largest number of sprinklers in any one (1) of the enclosed areas. When supplied by the domestic water system, the maximum number of sprinklers in any one (1) enclosed room or area shall not exceed twenty (20) sprinklers which must totally protect the room or area.

M-1006.6.1 Fire department connections: A fire department connection is not required for limited area sprinkler systems supplied from the domestic water system.

M-1006.6.2 Standpipe connection: The water supply for the limited area sprinkler system shall be from the building standpipe system when available. (see Section M-1012.4.1.)

M-1006.6.3 Cross connection: A limited area sprinkler system may be supplied individually from the domestic water system or from the standpipe system. There shall not be a cross connection between the domestic and standpipe system.

M-1006.7 Use of limited area sprinklers

M-1006.7.1 Limited area sprinklers shall be used only in rooms or areas enclosed with construction assemblies as required by the building code of this jurisdiction.

SECTION M-1007.0 WATER SPRAY FIXED SYSTEMS

M-1007.1 General: Water spray extinguishing systems shall be of an approved type and installed in accordance with the provisions of this code and NFiPA 15 listed in Appendix B.

M-1007.2 Design: The detail on the system supplied with the plans and specifications shall include information and the calculations on the sprinkler spacing and arrangement with water and discharge requirements, size and equivalent lengths of pipe and fittings and water supply source. Sufficient information shall be included to identify the apparatus and devices used.

M-1007.3 Actuation: Waterspray extinguishing system shall be the automatically actuated type with supplementary auxiliary manual tripping capability.

M-1007.4 Tests: All new system piping shall be hydrostatically tested in accordance with the provisions of the standard referenced above.

SECTION M-1008.0 FOAM EXTINGUISHING SYSTEMS

M-1008.1 General: Foam extinguishing systems shall be of an approved type and installed in accordance with the provisions of this code and NFiPA 11, 11A and 16 listed in Appendix B.

M-1008.2 Design: The detail on the system supplied with the plans and specifications shall include complete computations showing pressure drop in all system piping, friction loss calculations on liquid lines and a detailed layout of the entire hazard to be protected. Hydraulic characteristics of foam proportioners and foam makers as determined by tests shall be supplied by the manufacturer to the department (including the range of operating conditions required for the proposed installation), to permit determination of the adequacy of the hydraulics of the proposed protection.

M-1008.3 Actuation: A foam extinguishing system shall be automatically actuated with supplementary auxiliary manual tripping capability.

M-1008.4 Tests: All piping except that handling expanded foam shall be subjected to a two (2) hour hydrostatic pressure test at two hundred (200) psi or fifty (50) lbs. in excess of the maximum pressure anticipated, whichever is greater without leakage. The system shall be subjected to a flow test to insure that the hazard is fully protected in conformance with the design specification, and to determine the flow pressures, actual discharge capacity, foam quality, consumption rate of foam-producing materials, manpower requirements and other operating characteristics.

SECTION M-1009.0 CARBON DIOXIDE EXTINGUISHING SYSTEMS

M-1009.1 General: Carbon dioxide extinguishing systems shall be of an approved type and installed in accordance with the provisions of this code and NFiPA 12 listed in Appendix B.

M-1009.2 Design: The detail on the system supplied with the plans and specifications shall include information and calculations on the amount of carbon dioxide; the location and flow rate of each nozzle including equivalent orifice area; the location, size and the carbon dioxide storage facility. Information shall be submitted pertaining to the location and function of the detection devices, operating devices, auxiliary equipment, and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features should be adequately explained.

M-1009.3 Actuation: Carbon dioxide extinguishing systems shall be automatically actuated with supplementary auxiliary manual tripping capability.

M-1009.4 Safety requirements: In any proposed use of carbon dioxide where there is a possibility that men may be trapped in, or enter into, atmospheres made hazardous by a carbon dioxide discharge, warning signs, discharge alarms and breathing apparatus shall be provided to insure prompt evacuation of and to prevent entry into such atmospheres and also to provide means for prompt rescue of any trapped personnel.

M-1009.5 Tests: A completed system shall be tested for tightness up to the selector valve, and for continuity of piping with free unobstructed flow beyond the selector valve. The labeling of devices with proper designations and instructions shall be checked. Operational tests should be conducted on all devices except cylinder valves in multi-cylinder high pressure systems. Where conditions prevail that make it difficult to determine adequately the system requirements or design, a suitable discharge and analysis test should be made. All tests are to be conducted as indicated in the above standard.

M-1009.6 Range hoods: In addition to the above requirements and the requirements of Section M-1003.21, range hood CO_2 systems shall conform to the following requirements listed below.

1. Where multiple hoods are served, each hood shall be provided with a separate manual station (actuator) and a separate CO_2 supply.
2. Total CO_2 requirements shall be calculated on the following accumulative basis:
   a. open area of hood (sq. ft.) ÷ 0.6 = pounds of CO_2;
   b. volume of hood (cu. ft.) (minimum depth of two feet) ÷ 8.0 = pounds of CO_2;
   c. hoods located over liquid surface operations; liquid surface area (sq. ft.) ÷ 0.4 = lbs. CO_2 (10 lbs. minimum);
   d. volume of plenum (cu. ft.) ÷ 8.0 = lbs. of CO_2;
   e. volume of duct of fire damper (cu. ft.) ÷ 8.0 = lbs. of CO_2;
   f. duct above fire damper, minimum 10 lbs. CO_2; and
   g. in addition to the calculations, an additional 10 lbs. of CO_2 shall be provided as a safety factor.
3. Upon activation of the CO_2 system, the fan(s) shall cease to operate and the supply valve shall shut the pilot and burner(s) off.
4. Duct systems from range hoods shall not be equipped with fire dampers unless specifically approved for such use, or are required as part of an approved extinguishing system, or an approved fan by-pass system.
5. CO_2 bottles shall be located at least fifteen (15) feet from the range or range hood. The temperature in the storage area shall not ex-

ceed one hundred twenty (120) degrees F. or be less than thirty-two (32) degrees F.

6. An electric warning light of ten (10) watts or more shall be provided on the CO_2 bottle or system which will automatically illuminate when the bottle or system is depleted. The light shall be of a distinctive red color and shall be located in a conspicuous location.

SECTION M-1010.0 HALOGENATED EXTINGUISHING SYSTEMS

M-1010.1 General: Halogenated extinguishing systems shall be of an approved type and installed in accordance with the provisions of this code and NFiPA 12A and 12B listed in Appendix B.

M-1010.2 Design: The detail on the system supplied with the plans and specifications shall include information and calculations of the amount of extinguishing agent; container storage pressure; the location and flow rate of each nozzle including equivalent orifice area; the location, size and equivalent lengths of pipe, fittings and hose; and the location and size of the storage facility. Information shall be submitted pertaining to the location and size of the storage facility. Information shall be submitted pertaining to the location and function of the detection devices, auxiliary equipment, and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features should be adequately explained.

M-1010.3 Actuation: A halogenated fire extinguishing system shall be automatically actuated with supplementary auxiliary manual tripping capability.

M-1010.4 Safety requirements: In any proposed use of a halogenated fire extinguishing system where there is a possibility that men may be trapped in or enter into atmospheres made hazardous by a discharge, warning signs, discharge alarms and breathing apparatus shall be provided to insure prompt evacuation of and to prevent entry into such atmospheres and also to provide means for prompt rescue of any trapped personnel.

M-1010.5 Tests: A completed system shall be tested for tightness up to the selector valve, and for continuity of piping with free unobstructed flow beyond the selector valve. The labeling of devices with proper designations and instructions shall be checked. Operational tests should be conducted on all devices except cylinder valves in multi-cylinder systems. Where a condition prevails that makes it difficult to determine adequately the system requirements or design, a suitable discharge test or concentration analysis should be made. All tests are to be conducted as indicated in the above standard.

SECTION M-1011.0 DRY CHEMICAL EXTINGUISHING SYSTEMS

M-1011.1 General: Dry chemical extinguishing systems shall be of an approved type and installed in accordance with the provisions of this code and NFiPA 17 listed in Appendix B.

M-1011.2 Design: The details on the system supplied with the plans and specifications shall include sufficient information and calculations on the amount of dry chemical; the size, length, and arrangement of connected piping, or piping and hose; description and location of nozzles so that the adequacy of the system can be determined. Information shall be submitted pertaining to the location and function of detection devices, operating devices, auxiliary equipment and electrical circuitry, if used. Sufficient information shall be indicated to identify properly the apparatus and devices used. Any special features should be adequately explained.

M-1011.3 Actuation: A dry chemical extinguishing system shall be automatically actuated with supplementary auxiliary manual tripping capability.

M-1011.4 Safety requirements: Where there is a possibility that personnel may be exposed to a dry chemical discharge, warning signs, discharge alarms and breathing apparatus shall be provided to ensure prompt evacuation of such locations, and also to provide means for prompt rescue of any trapped personnel.

M-1011.5 Tests: A completed system shall be tested by a discharge of expellant gas through the piping and nozzles. Observations for serious gas leakage and for continuity of piping with free unobstructed flow shall be made. Observations shall be made of the flow of expellant gas through all nozzles. The labeling of devices with proper designations and instructions should be checked. After testing, all piping and nozzles are to be blown clean, using compressed air or nitrogen and the system properly charged and placed in the normal "set" condition. All tests are to be conducted as indicated in the above standard.

M-1011.6 Range hoods: In addition to the above requirements and the requirements of Section M-1003.21, range hood dry (chemical) systems shall conform to the following requirements listed below.

1. Dry chemical systems shall bear the label of a nationally recognized testing or inspection agency and shall be installed in accordance with their recommendations and shall be approved by the department and fire department.
2. The size of hood and duct covered by a single system shall not exceed the agency's recommendations.
3. Dry chemical agent used shall be non-toxic.
4. Multiple hoods may be protected by a common system if in conformance with a report of a nationally recognized testing or inspection agency.
5. Each duct system shall constitute an individual system serving only exhaust hoods on one (1) floor.

6. Dry chemical bottles shall be located at least fifteen (15) feet from the range or range hood, or as approved by the department and fire department.
7. A ten (10) pound approved portable type CO_2 extinguisher shall be provided and located not more than fifteen (15) feet and not less than ten (10) feet from the hazard.

SECTION M-1012.0 STANDPIPE SYSTEMS

M-1012.1 General: All buildings and structures shall be equipped with two and one-half (2½) inch or larger standpipes and made to comply with the requirement of this section.

M-1012.2 Where required: Standpipes shall be installed and maintained in full operating condition, as specified in this article and the standards listed in Appendix B, in the following locations indicated in Sections M-1012.2.1 through M-1012.2.3.

M-1012.2.1 Assembly (A-1, A-2, A-3) uses: In buildings of A-1, A-2 or A-3 use groups with an occupancy load of more than three hundred (300), regardless of the number of stories therein.

M-1012.2.2 In buildings three (3) stories in height, when:

1. of use groups S-1 (moderate hazard storage), M (mercantile), F (industrial), or B (business) more than three thousand (3,000) square feet in area per floor; or
2. of use groups A (assembly), I (institutional), or R-1 (residential: hotels); or
3. of any use group more than ten thousand (10,000) square feet in area per floor.

M-1012.2.3 In buildings four (4) stories or more in height, regardless of the area per floor.

M-1012.3 Sizes: Standpipes shall extend from the lowest portion of the building to a height five (5) feet above the finished floor of the topmost story and shall have a minimum diameter as shown in Table M-1012.3.

M-1012.4 Number of standpipe risers: The number of standpipe risers shall be such that all parts of every floor area can be reached by a thirty (30) foot hose stream from a nozzle attached to one hundred (100) feet of hose connected to a riser outlet.

M-1012.4.1 Combination: The standpipe system riser(s) may also serve as the water sprinkler system riser(s) in buildings required to have both systems or in buildings having both systems. A control valve shall be installed in each sprinkler system or standpipe to allow the system to remain operational.

M-1012.5 Outlets

Table M-1012.3
MINIMUM STANDPIPE SIZES

Maximum building height	Minimum standpipe size**
3 stories or 40 feet	2½ inches
4 stories or 50 feet	2½ inches
5 stories or 65 feet	4 inches
6 stories or 75 feet	4 inches
7* stories or 85 feet	6 inches
8* stories or 95 feet	6 inches
95* feet to 250 feet	6 inches
over 250* feet	8 inches

*At least one standpipe shall extend through the roof and terminate in a two-way, two and one-half (2½) inch hose connection.
**In sprinklered buildings, the minimum standpipe diameter may be based on hydraulic calculations.

M-1012.5.1 At each floor level, and not more than five (5) feet above the floor, there shall be connected to each standpipe a two and one-half (2½) inch hose connection and a one and one-half (1½) inch hose connection with valves and threads conforming to the local fire department's standard. Each one and one-half (1½) inch hose connection shall be equipped with one hundred (100) feet of one and one-half (1½) inch hose with an approved nozzle and couplings and hung in an approved rack or cabinet.

> **Exception:** In sprinklered buildings, the one and one-half (1½) inch hose connection, hose and cabinet are not required.

M-1012.5.2 Where standpipes extend through the roof, an approved hydrant or manifold shall be provided. The main control valve on a roof hydrant or manifold shall be located in an area not subject to freezing as close to the roof access as practical and plainly marked (see Section M-1000.5).

M-1012.6 **Material:** All standpipes shall be constructed of approved materials. All pipe, fittings and valves shall be of extra heavy pattern when the working pressure will exceed one hundred seventy-five (175) pounds per square inch (psi).

M-1012.7 **Capacity:** Standpipes of four (4) inch or six (6) inch size shall be capable of discharging a minimum of two hundred fifty (250) gallons per minute, or a minimum of five hundred (500) gallons per minute where more than one (1) standpipe is required, with a residual pressure of at least sixty-five (65) psi at the highest outlet of each standpipe.

SECTION M-1013.0 STANDPIPES FOR BUILDINGS UNDER CONSTRUCTION OR DEMOLITION

M-1013.1 **General:** Standpipes required by this section may be temporary or permanent in nature, with or without a water supply, provided, however, that such standpipes shall remain in service until completion of the work.

M-1013.2 Number required: Every building or structure under construction five (5) or more stories in height above grade, shall be equipped with one (1) or more standpipes at least four (4) inches in diameter. A sufficient number of standpipes with hose(s) shall be provided so that every portion of the building can be reached with one hundred (100) feet of hose and thirty (30) feet of hose stream.

M-1013.3 Construction: All standpipes shall be constructed of approved materials. All pipe, fittings and valves shall be extra heavy pattern when the working pressure exceeds one hundred seventy-five (175) psi.

M-1013.4 Height: The standpipe systems shall be carried up with each floor and shall be installed ready for use as each floor progresses. Standpipes shall not be more than one (1) floor below the highest forms or staging.

M-1013.5 Fire department connections: At the street level there shall be provided for each temporary or permanent standpipe installation one (1) or more two (2) way fire department inlet connections. Fire department inlet connections shall be prominently marked and readily and easily accessible at all times (see Section M-1014.8).

M-1013.6 Outlets: At each floor level and on each standpipe, there shall be provided one (1) two and one-half (2½) inch hose outlet and one (1) two and one-half (2½) inch hose valve with cap and chain. At each floor level and on each standpipe, there shall be provided a one and one-half (1½) inch hose outlet with one hundred (100) feet of approved hose. Outlets shall be located not more than five (5) feet above floor level.

> **Exception:** In sprinklered buildings, the one and one-half (1½) inch outlet is not required, however, the one and one-half (1½) inch hose line shall be provided with a one and one-half (1½) to two and one-half (2½) reducer (see Section M-1012.5.1).

M-1013.7 Standpipes for buildings under demolition: Where a building is being demolished and a standpipe is existing within such a building, such standpipe shall be maintained in an operable condition so as to be available for use by the fire department. Such standpipe shall be demolished with the building, but the standpipe shall not be more than one (1) floor below the floor above being demolished.

SECTION M-1014.0 FIRE DEPARTMENT CONNECTIONS
(See Section M-1013.5 for Temporary Standpipes)

M-1014.1 Required: All water sprinkler and standpipe systems shall be provided with at least one (1) two (2) way fire department connection.

Each inlet of the fire department connection shall be at least two and one-half (2½) inches in diameter. The pipe from the standpipe system to the fire department connection shall not be smaller than four (4) inches. The pipe from the water sprinkler system to the fire department connection shall not be smaller than four (4) inches. Single fire department connections may be installed when approved by the department.

Exception: A fire department connection shall not be required for limited area sprinkler systems (see Section M-1006.6.1).

M-1014.2 Connections: Fire department connections shall be arranged in such a manner that the use of any one (1) water sprinkler connection will serve all the sprinklers, and the use of one (1) standpipe connection will serve all the standpipes within the building.

M-1014.3 Location: Fire department connections shall be located and be visible on a street front or in a location approved by the department. Such connections shall be located so that immediate access can be made by the fire department. Obstructions such as fences, bushes, trees, walls or any other similar object, shall not be permitted for new or existing installations.

M-1014.4 Height: Fire department connections shall not be less than one (1) foot six (6) inches and not more than three (3) feet six (6) inches in elevation, measured from the ground level to the center line of the inlets.

M-1014.5 Projection: Where the fire department connection would project beyond the property line or into the public way, a flush-type fire department connection shall be provided.

M-1014.6 Hose threads: Hose threads in the fire department connection shall be uniform with that used by the local fire department.

M-1014.7 Fittings: Fire department inlet connections shall be fitted with check valves, ball-drip valves, and caps and chains.

M-1014.8 Signs: A metal sign with raised letters at least one (1) inch in height shall be mounted on all fire department connections serving sprinklers and/or standpipes. Such signs shall read *Automatic sprinklers* and/or *Standpipe.*

SECTION M-1015.0 WATER SUPPLY AND OTHER EXTINGUISHING SUPPLY MEDIA

M-1015.1 Required: All fire suppression and standpipe systems shall be provided with at least one (1) automatic supply of extinguishing material of adequate pressure, capacity and reliability to perform the function intended.

M-1015.2 Combination "sprinkler-standpipe" water supply: Where both sprinklers and standpipes are installed, they may have a common fire water service as their combined source of supply. The connection shall not be made to any water main of this jurisdiction of less than four (4) inches in diameter. In sprinklered buildings with combined standpipes, the water supply shall be adequate for the sprinkler system or the standpipe system, whichever is greater.

M-1015.3 Combination "sprinkler-domestic" water supply: A sprinkler system may be connected to the domestic water supply system as allowed by this code, provided the supply system is of adequate pressure capacity and size for the simultaneous operation of the water sprinkler system and domestic water needs. A check valve shall be installed in the water sprinkler supply line to prevent contamination of the domestic water.

M-1015.4 Size: The extinguishing material supply for fire suppression systems shall be sized in an approved manner in accordance with this code and the standards listed in Appendix B.

M-1015.5 Standpipes:

M-1015.5.1 Water service: Standpipes shall be connected to a street water main with a fire water service at least equal to the size of the largest standpipe within the building or shall be hydraulically calculated to satisfy total demand. The size of the water service at the base of the standpipe risers shall be at least the size of the largest standpipe.

M-1015.5.2 Interconnection: The required water supply shall be connected to the base of each standpipe. Where more than one (1) standpipe is required, all standpipes shall be interconnected at their base and an approved indicating valve shall be installed at the base of each standpipe so as to permit individual risers to be taken out of service if damaged or broken without interrupting the water supply to other risers.

SECTION M-1016.0 SUPERVISION

M-1016.1 Fire suppression systems: Valves controlling required fire suppression systems shall be supervised open by one (1) of the following methods:

1. approved central station system, proprietary system or remote station system of the jurisdiction;
2. local alarm service which will cause the sounding of an audible signal at a constantly attended location;
3. locking valves open; or
4. sealing of valves and approved weekly recorded inspection when valves are located within fenced enclosures under the control of the owner.

Exceptions:

1. underground gate valves with roadway boxes;

2. halogenated extinguishing systems;
3. carbon dioxide extinguishing systems;
4. dry chemical extinguishing systems; and
5. standpipe systems.

SECTION M-1017.0 YARD HYDRANTS

M-1017.1 Fire hydrants: Fire hydrants installed on private property shall be located and installed as directed by the fire department. Hydrants shall conform to the standards of the administrative authority of this jurisdiction and the fire department. Hydrants shall not be installed on a water main of less than six (6) inches in diameter.

ARTICLE 11

AIR POLLUTION CONTROL

SECTION M-1100.0 SCOPE

M-1100.1 General: In addition to other requirements of this code, this article shall govern the emissions of air pollutants within this jurisdiction.

SECTION M-1101.0 PURPOSE

M-1101.1 General: The purpose of this article is to provide for control, and regulation of activities which cause, or may cause, pollution or contamination of the air, as required for the protection of public health, safety and general welfare. It is the intent of this article to provide and maintain such standards of air quality as will assure that the atmosphere will be adequately pure and free from smoke, pollutants or synergistic agents which are, or may be, injurious to human, plant or animal life, or to property, or which interfere with the conduct of business and to that end, to require the use of all available practicable and reasonable methods for the prevention and control of air pollution.

SECTION M-1102.0 ENTRANCE TO PREMISES

M-1102.1 General: In addition to the requirements of the building code, admission to any premises shall be granted to the department at all reasonable times upon presentation of proper credentials. A qualified person from the premises involved may accompany the department, provided that such person is made available without unnecessary delay, so as not to obstruct the purpose of the investigation.

M-1102.2 Interference: A person shall not hinder, obstruct, delay, resist, prevent in any way, interfere or attempt to interfere with the department in the performance of its duties in investigation of a suspected air pollution violation.

SECTION M-1103.0 REGISTRATION

M-1103.1 General: Any device, the use of which may cause, control or prevent air pollution, shall be registered with the department. Registration shall include the name and the address of the firm, the location of the device, the name of the person responsible for the operation of the device and other such information as may be required by the department.

SECTION M-1104.0 PERMITS

M-1104.1 General: Any person building, installing, altering or replacing any device, the use of which may cause, control or prevent air pollution, shall first submit plans for review to the department and obtain a permit for this work.

SECTION M-1105.0 EQUIPMENT AND PROCESSES

M-1105.1 General: Use of any device or process, built, installed, altered, or replaced, on or after the effective date of this code, shall neither violate nor result in any violation of the provisions of this article.

M-1105.2 Existing devices: Devices or processes, built, installed, altered or replaced prior to the effective date of this code shall be considered to be "existing," and if in violation of the provisions of this code during actual use, shall be properly equipped or modified to comply. A reasonable time, as determined by the administrative authority, shall be allowed for achieving compliance.

M-1105.3 Concealed emissions: It shall be unlawful to use any device or condition to conceal or to dilute the emission of a pollutant or pollutants without actually controlling such emission at, or below, the limits established by this article.

SECTION M-1106.0 PARTICULATE MATTER IN GASES

M-1106.1 Combustion gases: Particulates, in gases from the combustion of any fuel, shall not exceed twenty-hundredths (0.20) pounds per one thousand (1,000) pounds of gas, adjusted to twelve (12) per cent CO_2, measured at any point in the stack or stack breaching, or downstream of the final air pollution control device, if such exists. Particulate shall not be larger than twenty (20) mesh, Tyler Standard Screen Scale, one thirty-second (1⁄32) inch in its larger dimension.

M-1106.2 Non-combustion gases: Particulates in non-combustion gases shall not exceed twenty-hundredths (0.20) pounds per one thousand (1,000) pounds of undiluted gas, measured at any point in the discharge system or downstream of the final air pollution control device, if such exists. Particulate shall not be larger than twenty (20) mesh, Tyler Standard Screen Scale one thirty-second (1⁄32) inch in its larger dimension.

SECTION M-1107.0 RINGELMANN STANDARDS

M-1107.1 General: A person shall not discharge, or cause or permit to be discharged into the atmosphere, from any single source of emission built, erected, established, installed, altered or replaced subsequent to the effective date of this code, any air pollutant or pollutants for a period aggregating more than three (3) minutes during any sixty (60) minute period which is:

1. as dark, or darker, in shade as that designated as No. 1 on the Ringelmann chart;
2. of opacity equal to, or greater than, smoke specified in 1 immediately above; and
3. of any shade or opacity equal to, or greater than, that specified in both 1 and 2 immediately above, and designated under any other nationally accepted measuring system which is comparable to the Ringelmann method.

M-1107.2 Existing emission sources: A person shall not discharge, or cause or permit to be discharged into the atmosphere, from any single source of emission existing on the effective date of this code, any air pollutant or pollutants for a period aggregating more than three (3) minutes during any sixty (60) minute period which is:

1. as dark, or darker, in shade as that designated No. 2 on the Ringelmann chart;
2. of opacity equal to, or greater than, smoke described in 1 immediately above;
3. of any shade or opacity equal to, or greater than, that specified in both 1 and 2 immediately above, and designated under any other nationally accepted measuring system which is comparable to the Ringelmann method.

SECTION M-1108.0 SULFUR DIOXIDE

M-1108.1 Ground-level concentrations: A person shall not cause or permit any emission of sulfur dioxide, or gas containing sulfur dioxide, which results in average ground-level concentrations of sulfur dioxide at any given point in excess of one (1) part per million (ppm) based on volume of sulfur dioxide in a twenty (20) minute period of any hour, and average exposure shall not exceed three-tenths (0.3) part per million, based on volume, in any eight (8) hour period. Such limitations shall not apply to ground-level concentrations occurring on the property from which emission occurs, if such property, from the point of emission to the point of any concentration, is controlled by the person responsible for such emission.

M-1108.2 Exhaust gases: A person shall not cause or permit the emission of sulfur dioxide, or gas containing sulfur dioxide, in excess of two-thousand (2,000) parts per million of sulfur dioxide, based on volume. All sampling of exhaust gases shall be conducted following techniques designated by the air pollution control section of the building department of this jurisdiction. For the purpose of this section, all sulfur present in gaseous compounds which contain oxygen shall be deemed to be present as sulfur dioxide, and analyses of samples taken to determine the amount of sulfur dioxide in exhaust gases shall be made as specified by the department. Tests for determining compliance with this section shall be for at least fifteen (15) consecutive minutes or ninety (90) per cent of the time of actual source operation, whichever is less.

SECTION M-1109.0 VISIBLE EMISSIONS FROM INTERNAL COMBUSTION ENGINES

M-1109.1 General: A person shall not cause or permit the emission of visible air pollutants in amounts in excess of those specified in Section M-1107.2 from any of the following internal combustion engines under his ownership or control:

1. portable or stationary equipment for longer than ten (10) consecutive seconds; or
2. a vehicle including, but not limited to, gas or diesel powered automobiles, trucks, tractors, railroad engines, boats, farm or construction machinery and aircraft, regardless of fuel used, while said vehicle is stationary for longer than ten (10) consecutive seconds; or
3. a motor vehicle, after the vehicle has moved more than one-hundred (100) yards from standstill.

M-1109.1.1 Section M-1109.1 shall not apply when the presence of uncombined water is the only reason for the failure of an emission to meet the requirements of this section.

M-1109.1.2 The owner of any vehicle found to be in violation of this section by reason of its mechanical condition shall present to the air pollution control section of the building department of this jurisdiction, within two (2) weeks after citation for such violation, written evidence of the performance of the work necessary to remedy the condition which caused the violation. This written evidence shall be a letter of performance, from a qualified repair garage, or state-approved motor vehicle checking station, describing the work performed and attesting that the offending condition has been remedied.

Exception: If the repairs are made by any other than a qualified repair garage or state-approved motor vehicle checking station, or where correction of the condition causing the violation, or proof that same has been accomplished is impossible or impractical under the alternate methods of this section, the air pollution control section of the building department of this jurisdiction shall, in a written order, specify the time, place and test conditions under which evidence of compliance shall be presented by the alleged violator, but the time shall not be less than the two (2) weeks stipulated above.

SECTION M-1110.0 STORAGE OF PETROLEUM PRODUCTS

M-1110.1 General: Any storage, holding, stationary tank, reservoir or other container having a capacity of forty thousand (40,000) U.S. gallons, constructed on or after the effective date of this code, and used for any gasoline or any petroleum distillate having a vapor pressure of one and one-half (1½) pounds per square inch (psi) absolute, or greater, under actual storage conditions, unless such tank, reservoir, or other container is a pressure tank maintaining working pressures at all times to prevent hydrocarbon or gas loss to the atmosphere, shall be designed and equipped with one (1) of the following vapor loss control devices, properly installed in good working order and in operation.

1. A floating roof, consisting of a pontoon type or double-deck type roof, resting on the surface of the liquid contents and equipped with a closure seal, or seals, to close the space between the roof edge and tank wall. The control equipment provided for in this paragraph shall not be used if the gasoline or petroleum distillate has a vapor pressure of eleven (11) pounds per square inch absolute, or greater, under actual storage conditions. All tank gauging and sampling devices shall be gas-tight except when gauging or sampling is taking place.
2. A vapor recovery system, consisting of a vapor gathering system capable of collecting the hydrocarbon vapors and gases so as to prevent their emission to the atmosphere, and with all tank gauging and sampling devices gas-tight, except when gauging or sampling is taking place.
3. Other equipment of equal efficiency, provided that plans for such equipment are submitted to, and approved by, the department prior to construction or installation of said equipment.

SECTION M-1111.0 REDUCTION OF ANIMAL MATTER

M-1111.1 General: A person shall not operate or use any device for the reduction of animal matter, unless all gases, vapors and gas-entrained effluents from such device are:

1. incinerated at a temperature of not less than twelve hundred (1200) degrees F. for a period of not less than three-tenths (0.3) seconds; or
2. processed in a manner determined by the department to be equally, or more, effective for the purpose of air pollution control than 1 above.

A person incinerating or processing gases, vapors or gas-entrained effluents pursuant to this section shall provide, properly install and maintain in calibration, in good working order and in operation devices, as specified by the department, for indicating temperature, pressure or other operating conditions. This section shall be effective on the date of its adoption as to any device, used for the reduction of animal matter, not completed and put into service. As to all other such devices, this section shall be effective retroactively without limitation.

SECTION M-1112.0 EMISSION OF SETTABLE ACID AND ALKALINE SUBSTANCES

M-1112.1 General provision: This regulation shall apply to all such emissions from any source or from any premises.

M-1112.2 Method of measurement

M-1112.2.1 The fallout sampling devices used in determining compliance with this section shall consist of circular glass dishes fifteen (15) centimeters in diameter. The dishes shall be supported on a nearly horizontal surface not larger than the dish. The dish bottom shall be at least three (3) feet above the earth or other surface on which its support is resting. The dish shall be coated with an acid-base indicating substance. Prepared dishes shall be stored in a dessicator or in sealed plastic bags.

M-1112.2.2 Fallout sampling devices shall be put in place at one (1) or more locations up-wind and down-wind of the premises at locations beyond the premises on which a source or sources are located. They shall be left exposed to substances settling out of the ambient air for a period of one (1) hour. The presence of characteristic colored spots, visible to the naked eye, on the samplers used to measure fallout of acidic substances shall be construed to mean that acidic substances have settled out of the air. The presence of characteristic colored spots, visible to the naked eye, on the samplers used to measure fallout of alkaline substances shall be construed to mean that alkaline substances have settled out of the air. The number of spots, visible on samplers up-wind of the premises, is to be substracted from the number of spots visible on samples exposed down-wind of the same premises. The difference in the number of spots shall be construed to be attributable to emissions occurring on the premises under investigation.

M-1112.3 Restricted emissions: A person shall not cause or permit the emission from any source or premises of substances having acidic or alkaline properties in such manner and amounts that the fallout rate of acidic or alkaline substances is greater than five (5) spots more at the down-wind sampling site, as measured in the manner described in Section M-1112.2.2.

SECTION M-1113.0 INCINERATION

M-1113.1 General: Refuse shall not be burned in any incinerator except as provided for in this code, or in any equipment, unless found by the department, prior to its use, to be equally as effective for the purpose of air pollution control as an approved incinerator.

M-1113.2 Smoldering: Smoldering is prohibited.

SECTION M-1114.0 OPEN BURNING

M-1114.1 General: Open burning, or the addition of fuel to such burning, is unlawful, unless approved by the department, in writing, in advance of such burning.

Exceptions:

1. fires used for the non-commercial cooking of food for humans;
2. smokeless safety flares for the combination of gases; and
3. fires for instruction in firefighting procedures, under the auspices of the fire service of this jurisdiction with the approval of this department.

SECTION M-1115.0 NUISANCE

M-1115.1 General: The emission or escape into the open air, within this jurisdiction, from any source or sources whatsoever of air pollution, in such manner or in such amounts as to be, or as to tend to be, detrimental to the health, comfort, safety, or welfare of, or as to cause annoyance or discomfort to, or as to be offensive and objectionable to persons exposed thereto, or as to cause or as to tend to cause injury or damage to property, or as to interfere with the normal conduct of business, is hereby declared to be, and shall constitute, a public nuisance. It shall be unlawful for any person to cause, permit or maintain any such public nuisance.

SECTION M-1116.0 CONDITIONS NOT IN VIOLATION OF THIS ARTICLE

M-1116.1 General: Emissions, exceeding any of the limits established in this regulation, as a direct result of upset conditions in, or breakdown of, any operating equipment or related air pollution control equipment, or as a direct result of the shutdown of such equipment for scheduled maintenance, shall not be deemed in violation of this article, provided that the department is notified without delay, in person or by telephone that necessary and prompt action is being taken to correct the conditions causing said violation. Such notification shall be followed, within three (3) days, by written confirmation to the department.

SECTION M-1117.0 PENALTIES AND OFFENSES

M-1117.1 General: Any person, found guilty of violating any provision of these regulations or any lawful order or notice from the department pertaining to these regulations, shall be subject to the fines or penalties as prescribed by this section. Whenever, in any section of this code, or any section, rule or regulation promulgated hereunder, the performances of any act is required, prohibited, or declared to be unlawful, and a definite fine or penalty is not provided for a violation thereof, any person, firm or corporation, who shall be convicted of a violation of any such section shall, for each offense, be fined the sum of not more than *[insert amount]* or shall be both so fined and so imprisoned. Each day's violation shall constitute a seperate offense. The suspension or revocation of any license, certificate, permit or other privilege, conferred by this jurisdiction, shall not be regarded as a penalty for the purpose of this code.

SECTION M-1118.0 RIGHT OF APPEAL

M-1118.1 General: Appeals may be made in accordance with the provisions of this article and the building code of this jurisdiction.

SECTION M-1119.0 VARIANCES

M-1119.1 General: The board of appeals may grant a variance, suspending or modifying the enforcement of any emission standard, or any rule, regulation or enforcement order issued pursuant to this article against any person, whenever the said board of appeals shall determine that such variance would be consistent with the purpose of this article.

M-1119.2 Unreasonable enforcement: The board of appeals shall grant a variance suspending or modifying the enforcement of any emission standard or any rule, regulation or enforcement order issued pursuant to this article against any person, whenever the said board of appeals shall determine that strict compliance with any provision of, or order issued pursuant to this article would result in an arbitrary and unreasonable taking of property or in the practical closing of any lawful business or activity and which would be without sufficient corresponding public benefit.

M-1119.3 Public hearing: The variance shall be granted, terminated or modified only after a public hearing before the board of appeals, held pursuant to the provisions of this article. A variance may be granted with respect to any existing or proposed facility, process or activity. Hearings may be requested either by the board of appeals, the department or by any person applying for or having received such a variance.

M-1119.4 Duration: Any variance granted pursuant to the provisions of this article shall be granted for such period of time and under such conditions as shall be specified by the board of appeals. The failure to meet any condition of the variance without prior written permission of the said board of appeals shall render such variance null and void. The board of appeals shall review, at least annually, any variance that has been granted to determine whether the terms and conditions of said variance have been complied with and whether the continuance of the variance is justified.

SECTION M-1120.0 HEARINGS

M-1120.1 General: Not less than fifteen (15) days after a hearing has been requested pursuant to Section M-1119.0 of this article, the board of appeals shall grant such hearing request and set a time and place therefor.

M-1120.2 Department participation: The department may appear as a party in any hearing before the board of appeals and shall have the same rights to judicial review as any other party.

M-1120.3 Record of proceedings: All testimony taken at any such hearing before the board of appeals shall be under oath or affirmation. A full and complete record of all proceedings and testimony presented shall be taken by electric devices or by stenographic means and filed. The secretary of the board of appeals shall furnish, upon payment and receipt of any fees allowed therefor, a certified transcript of the whole or any part of his record to any party in such hearing requesting the same.

M-1120.4 Confidential information: Any information relating to secret processes, methods of manufacture, or production, which may be required, ascertained or discovered shall not be publicly disclosed in public hearings or otherwise and shall be kept confidential by any member, officer or employee of the board of appeals or the department.

M-1120.5 Public participation: At any hearing, opportunity to be heard with respect to the subject thereof shall be given to the public to the extent deemed reasonable and proper by the board of appeals.

M-1120.6 Action of board: After due consideration of the written and oral statements, the testimony and the arguments presented in any such hearing, the board of appeals shall enter its findings and final order or make such final determination of the matter as it shall deem appropriate.

SECTION M-1121.0 JUDICIAL REVIEW

M-1121.1 General: Any final order or determination by the board of appeals (including any final action taken with respect to an application for a variance as provided in this article) shall be subject to judicial review in accordance with the provisions of this article and the provisions of the building code of this jurisdiction.

M-1121.2 Adduce additional evidence: Any party may move the court to remand the case to the board of appeals, in the interest of justice, for the purpose of adducing additional specified and material evidence and findings thereon, provided that such party shall show reasonable grounds for the failure to adduce such evidence previously before the said board of appeals.

SECTION M-1122.0 ADDITIONAL REMEDIES

M-1122.1 General: In the event any person fails to comply with a cease and desist order that is not subject to a stay, pending administrative review, this jurisdiction, or any proper person, may institute any appropriate action or proceeding to prevent any further or continued violation of such order. In any such suit, any finding of the board of appeals shall be prima facie evidence of the fact or facts found therein. Any such proceeding may be consolidated with judicial review of any final order or determination of the board of appeals. The imposition of any penalty hereunder shall not preclude this jurisdiction or any proper person from instituting any appropriate action or proceeding to prevent any further or continued violation of such order.

APPENDIX A

ACCREDITED AUTHORITATIVE AGENCIES

Electrical

Institute of Electrical and
Electronics Engineers, Inc.
345 East 47th Street
New York, New York 10017..........IEEE

Equipment

Air-Conditioning and Refrigeration
Institute
1815 North Fort Myer Drive
Arlington, Virginia 22209 ....ARI

American Gas Association
8501 E. Pleasant Valley Road
Independence, Ohio 44131.............AGA

American Petroleum Institute
1625 K Street, NW
Washington, D. C. 20005.................API

American Society of Heating,
Refrigerating and Air-Conditioning
Engineers
345 East 47th Street
New York, New York 10017....ASHRAE

The American Society of Mechanical
Engineers
United Engineering Center
345 East 47th Street
New York, New York 10017.........ASME

Home Ventilating Institute
230 N. Michigan Avenue
Chicago, Illinois 60601.....................HVI

Incinerator Institute of America
2425 Wilson Boulevard
Arlington, Virginia 22201..................IIA

The Institute of Boiler and
Radiator Manufacturers
393 Seventh Avenue-10th Floor
New York, New York 10001.............IBR

National LP-Gas Association
79 West Monroe Street
Chicago, Illinois 60603...............NLPGA

National Oil Fuel Institute, Inc.
60 East 42nd Street
New York, New York 10017.........NOFI

Sheet Metal & Air
Conditioning Contractors
National Association, Inc.
1611 North Kent Street
Suite 200
Arlington, Virginia 22209.......SMACNA

General Standards and Testing Laboratories

American National Standards
Institute, Inc.
1430 Broadway
New York, New York 10018...........ANSI

American Society for Testing
and Materials
1916 Race Street
Philadelphia, Pennsylvania
19101 ....ASTM

Factory Mutual Engineering Division
Standards-Laboratories Department
1151 Boston-Providence Turnpike
Norwood, Massachusetts
02062 ....FMED

National Fire Protection Association
470 Atlantic Avenue
Boston, Massachusetts 02110......NFiPA

National Sanitation Foundation
Testing Laboratory, Inc.
3475 Plymouth Road
P. O. Box 1468
Ann Arbor, Michigan 48106......NSFTL

Underwriters' Laboratories, Inc.
207 East Ohio Street
Chicago, Illinois 60611.....................ULI

Government Agencies

Federal Specifications
Superintendent of Documents
Government Printing Office
Washington, D. C. 20234..................FS

Department of Transportation
400 7th Street, SW
Washington, D. C. 20024..............DOT

National Bureau of Standards
(Department of Commerce)
Washington, D. C. 20234.................NBS

Product Standards Section
Office of Engineering Standards
Services
National Bureau of Standards
Washington, D. C. 20234.................PS

Superintendent of Documents
Government Printing Office
Washington, D. C. 20402...............GPO

United States Bureau of Mines
Department of the Interior
Washington, D. C. 20240............USBM

United States Department of
Commerce
Construction Division
Washington, D. C. 20225............USDC

Metal and Steel

American Institute of Steel
Construction, Inc.
1221 Avenue of the Americas,
Suite 1580
New York, New York 10020........AISC

American Iron and Steel Institute
1000 - 16th Street, N.W.
Washington, D. C. 20036..............AISI

American Welding Society, Inc.
2501 N. W. 7th Street
Miami, Florida 33125....................AWS

Unclassified Miscellaneous

Air Moving and Conditioning
Association
30 West University Drive
Arlington Heights, Illinois
60004 ....AMCA

American Public Health Association
1790 Broadway
New York New York 10017........APHA

American Society of
Sanitary Engineering
960 Illuminating Building
Cleveland, Ohio 44113..................ASSE

American Water Works Association
6666 W. Quincy Ave.
Denver, Colorado 80235............AWWA

Building Officials and Code
Administrators International
1313 East 60th Street
Chicago, Illinois 60637................BOCA

APPENDIX B

ACCEPTED ENGINEERING PRACTICE STANDARDS

See also Appendix C for standards on specific materials or tests of units or assemblies, some of which include engineering practice standards for specific applications.

General

Basic Building Code	BOCA–1975
Basic Fire Prevention Code	BOCA–1975
Basic Plumbing Code	BOCA–1975
Handbook of Applications and Fundamentals	ASHRAE–1972

Air Conditioning and Ventilating Equipment

Air Conditioning and Ventilating Systems of Other Than Residence Type—Standard for the Installation of	NFiPA 90A–1974
Air Conditioning, Warm Air Heating and Residence Type—Standard for the Installation of	NFiPA 90B–1973
Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying—Standard for the Installation of	NFiPA 91–1973
Gas-Fired Absorption Summer Air Conditioning Appliances—Standard for	ANSI Z21.40.1–1973
–Addenda to ANSI Z21.40.1–1973	ANSI Z21.40.1a–1974
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–Local Protective–for Watchman, Fire Alarm and Supervisory Service	NFiPA 72A–1974
–Proprietary Protective–for Watchman, Fire Alarm and Supervisory Service	NFiPA 72D–1974
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Explosive and Other Dangerous Articles, Shipping Containers, Specifications for Transportation of Parts 100 to 199	DOT-49CFR
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Oxygen-Fuel Gas Systems for Welding and Cutting—Standard for the Installation and Operation of	NFiPA 51–1974
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Stationary Combustion Engines and Gas Turbines—Standard for the Installation and Use of	NFiPA 37–1970
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Protective Lining and Coating for Steel Water Pipe 4" and Larger, shop applied—Standard for Cement Mortar	AWWA C205–1971
Reduced Pressure Principle Backflow Preventors	ASSE 1013–1971
Refrigeration Piping, including Addenda B31.5a–1968	ANSI B31.5–1966
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Mechanical Refrigeration—Safety Code for	ASHRAE 15–1970 also ANSI B9.1–1971
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APPENDIX C

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Cast Iron and Ductible Iron Pressure Pipe—Specifications for	ASTM A 377–73
Cast Iron Soil Pipe and Fittings—Specifications for	ASTM A 74–72
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Resisting Steel Weaving Wire—Specifications for	ASTM A 478–70
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Flash Point by Pensky-Martens Closed Tester—Test for	ASTM D 93–73
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Surface Burning Characteristics of Building Materials—Test for	ASTM E 84–70

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Ringelmann Smoke Chart	USBM IC–8333
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Water Pressure Reducing Valves for Domestic Water Supply Systems—Self-Contained, Direct-Acting, Single Seat, Diaphragm Type—Specifications for	ASSE 1003–1970

APPENDIX D

WATER SPRINKLER SYSTEMS WITH BASIC COMPONENTS

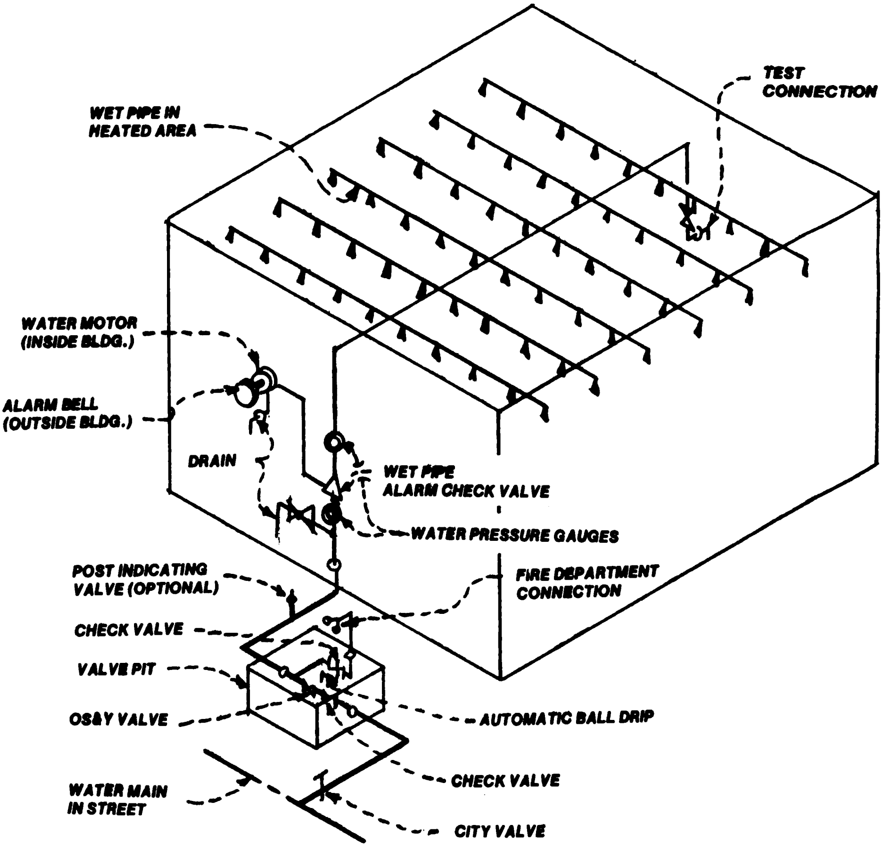
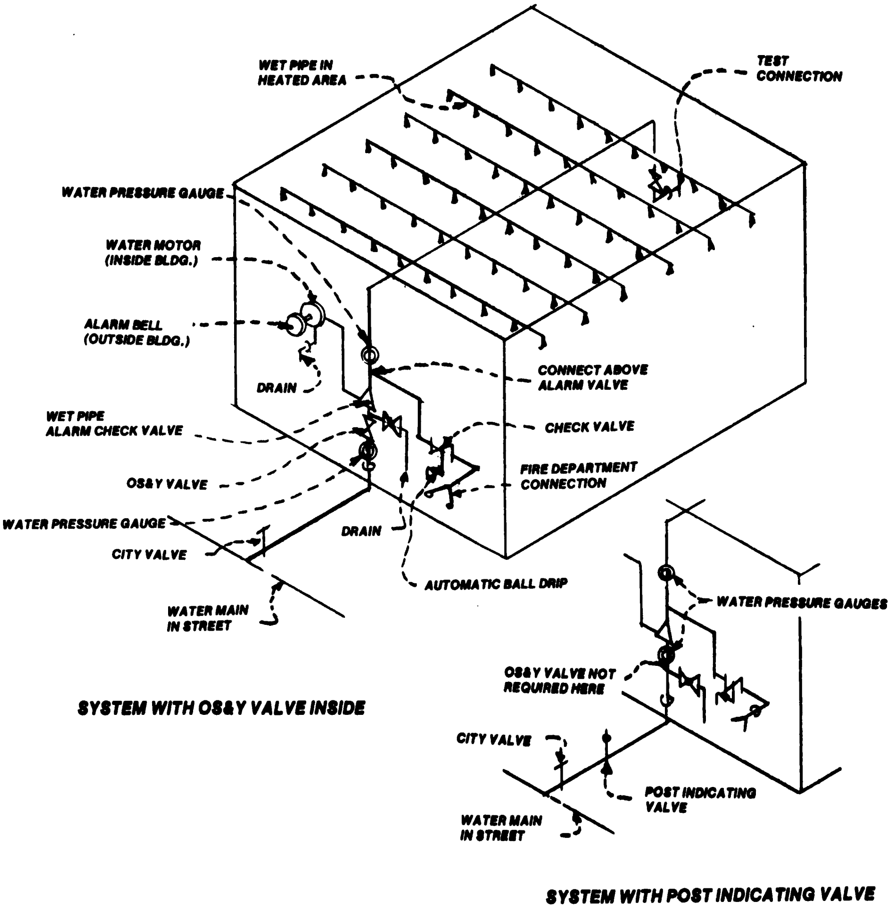


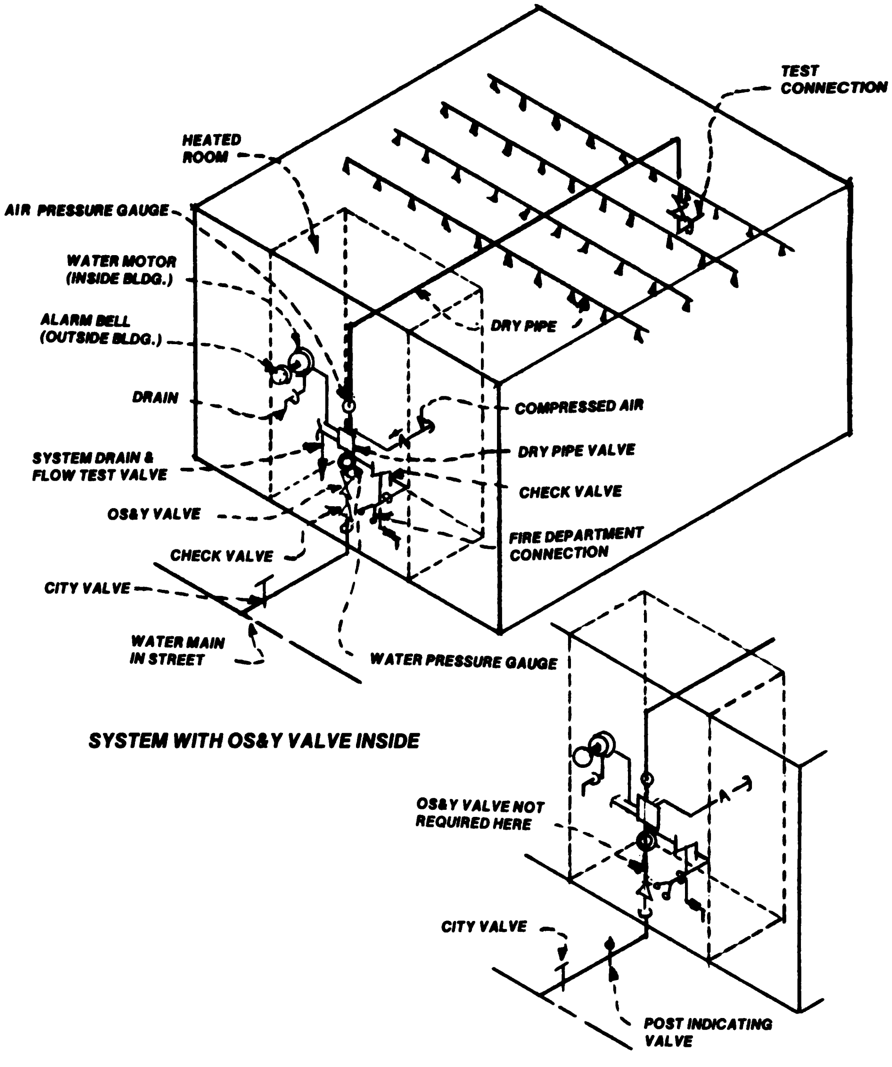
Figure D-1
TYPICAL WET SPRINKLER SYSTEM
WITH OUTSIDE VALVE PIT



SYSTEM WITH OS&Y VALVE INSIDE

SYSTEM WITH POST INDICATING VALVE

Figure D-2
TYPICAL WET SPRINKLER SYSTEM



SYSTEM WITH OS&Y VALVE INSIDE

SYSTEM WITH POST INDICATING VALVE

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